A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

JULY, 1936.

GENERAL PHYSICS.

ADSORPTION.

2921. Activated Adsorption of Hydrogen on Chromic Oxide Gel. R. L. Burwell, Jr., and H. S. Taylor. *Am. Chem. Soc., J.* 58. *pp.* 697–705, *May*, 1936.—Rates of adsorption of H_2 on several varieties of chromic oxide gel are determined at temperatures from 195 to 491° K. and at pressures from 0·125 to 1 atmosphere. Analysis of the data leads to the conclusion that the surface of chromic oxide gel is composite, with areas having characteristic activation energies of H_2 adsorption ranging from low values to a value of 21·7 k.cal./mol. This latter obtains on an area relatively uniform and large in extent. The influence of temperature, pressure and occupied surface on the velocity of adsorption on the uniform area are studied. The data lead to the conclusion that the slow process of adsorption may be described as an interaction between molecules adsorbed by van der Waals forces and surface atoms which receive the necessary activation energy. Such a process is in accord with previous observations on the velocities of adsorption of H_2 and D_2 at atmospheric pressure on chromic oxide gel in the same temperature range.

AUTHORS.

2922. Activation of Charcoal in Air. J. W. McBain and R. F. Sessions. *J. Phys. Chem.* 40. *pp.* 603–611, *May*, 1936.—The present work is effected upon redwood and sugar charcoals. The results differ from those of Lamb, Wilson and Chaney in that not only is a peak of activation found at the temperature range between 350° and 450°, but also a more pronounced peak with still better activation occurs between 920° and 960° C. Above this the activity of the charcoal falls off rapidly. Temperature is, therefore, the most important factor in the degree of activation. Sugar originally carbonised at 900° C., may still be activated, contrary to usual opinion. When kept, even in sealed tubes, over a period of time activity is lost from 17 to 63 %, but if the charcoal has sorbed organic vapour and is kept in contact with the vapour, then it loses no activity for many years. A stationary furnace inclined at an angle of 60° gave better activation results than a horizontal furnace and the Dubinin rotating furnace the best results of all. Charcoal attains a much higher degree of activity in air than when heated in N_2 or He only.

S. G. B.

2923. Wood-Water Relationships. Part II. W. W. Barkas. *Phys. Soc., Proc.* 48. *pp.* 576–586 ; *Disc.*, 586–588, *July* 1, 1936.—In order to determine the fibre saturation point of beech wood as accurately as possible, the vapour-pressure isothermal at high relative vapour pressures is measured on small blocks at 23° C., both for the adsorption cycle and for desorptions from three moisture-contents of 83, 47 and 120 %, the last value representing approximately complete saturation of the cell structure. Whereas on adsorption a vapour pressure indistinguishable from saturation appears to be reached at about 45 % moisture-content, which is much higher than that indicated by most routine methods, it is shown that on desorption the vapour pressure drops slightly at a moisture-content of about 90 % and also that the shape of the subsequent desorption curve is considerably influenced by the initial saturation moisture-content from which the drying commences. The observation made by Urquhart [see Abstract 360 (1930)] on natural cotton, that the first desorption cycle is not reproducible once the material has been completely dried, is found to apply also in the case of beech wood. It is pointed out that there is no discontinuity in size between the botanical and colloidal capillaries and that therefore the fibre saturation point cannot be defined, except as an approximate point at which the change of moisture-content begins to produce an appreciable effect on the particular property of wood under consideration. AUTHOR.

2924. Adsorption of Radium Ions on Glass and Gouy's Theory. V. M. Wdowenko and A. G. Samoilowich. *Acta Physicochimica*, 4. 4. *pp*. 613-616, 1936. *In English.*—Two series of logarithmic curves have been plotted for amount of Ra adsorbed on glass, (I) against concentration of Ra^{++} $(0 - 4 \times 10^{-8})$, for different *p*H, and (II) against *p*H (2 — 7) for different concentrations of Ra^{++}. In both cases the curves are approximately straight lines, which, as also the differences between the curves for different *p*H in series I and for different concentrations of Ra^{++} in series II, is shown to be in accordance with results of applying Gouy's theory to multivalent ions. C. A. S.

2925. Reversibility of Adsorption of Dissolved Substances on Ash-free Charcoals. L. Lepin and G. Strachowa. *Zeits. f. phys. Chem.* 176. *Abt.A.* 4. *pp*. 303–312, 1936.—Strong mineral acids such as HCl and H_2SO_4 and weak aliphatic acids, such as formic and acetic, are investigated with respect to their adsorption by charcoal. Adsorption and desorption isotherms are measured. The method of measurement differs from the usual in that the whole series of adsorption and desorption measurements for any given substance was carried out with the same quantity of adsorbent. Acetic acid, the adsorption of which can be considered to be largely a molecular van der Waals adsorption, has an adsorption isotherm which practically coincides with its desorption isotherm. Formic acid, the adsorption of which by charcoal is partly molecular and partly due to surface reactions of its carboxyl group, shows a small but marked separation for the two curves. Highly dissociated acids, the adsorption of which is chiefly due to surface reactions, give a wide separation between the two isotherms. Repeating adsorption and desorption measurements for the same weight of adsorbent leads to the formation of the same curve, which is thus a simple, easily reproducible hysteresis curve. It is stated that the experimental results agree well with the theory of surface reactions. J. K.

***2926. Preparation and Measurement of Adsorbing Surfaces. F. Durau and G. Tschoepe.** *Zeits. f. Physik*, 100. 3–4. *pp*. 145–165, 1936.—A description is given of an apparatus in which molten metals or salts can be forced through an aperture by compressed N_2. Under suitable conditions the salts solidify in N_2 to spheres and the metals to spheres or threads according to the temperature and pressure used. It is claimed that this method gives adsorbing surfaces of measurable extent and of more uniform character than can be obtained by other means. Experiments are carried out with Pb, Sb, Zn, Bi, Cd, Wood's metal, $NaNO_3$, KNO_3, $CdCl_2$ and $PbCl_2$. The surface of $PbCl_2$ spheres, as determined by a radioactive method, is found to be 170 times greater than that obtained by geometrical measurement. On the other hand experiments on the rate of solution of zinc threads in glacial acetic acid indicate that the true surface of metal threads and spheres made by the authors' method probably does not differ greatly from the geometrically measured surface. L. A. W.

2927. Effect of Illumination on the Power of Adsorption of Solid Substances. Part I. J. A. Hedvall. *Zeits. f. phys. Chem.* 32. *Abt.B.* 5. *pp.* 383–395, 1936.—Investigations on orientation have been carried out by studying the effects of illumination of crystal surfaces with respect to adsorption. It is shown that the degree of adsorption is dependent on the nature of the adsorbent and on the rays employed, and that the effect is quantitatively of such value as to necessitate a greater exactitude of measurement than is usually required as for example in chemical reactions and catalysis. P is the first substance to be studied, but similar results have been obtained for other substances under suitable illumination. J. K.

See also Abstracts **3052, 3217.**

ATOMIC AND MOLECULAR STRUCTURE.

2928. Theory of the Lightest Nuclei. H. Dolch. *Zeits. f. Physik,* 100. 7–8. *pp.* 401–439, 1936.—The possiblity is investigated of calculating the known mass defects of the three lightest nuclei, *viz.*, deuterons, tritons and He by taking account only of the neutron-proton exchange energy. Both Majorana's and Feenberg's potential functions are used in the calculations [see Abstracts 2923 (1933) and 1009 (1935)]. The collision area for a disintegration of a deuteron by a deuteron and the elastic collision of neutrons and protons is calculated. J. E. R. C.

2929. Nuclear Physics. Part I. Stationary States of Nuclei. H. A. Bethe and R. F. Bacher. *Rev. Modern Physics.* 8. *pp.* 82–229, *April,* 1936.—A critical review under the following headings : (i) Fundamental Properties of Nuclei ; (ii) Qualitative Arguments about Nuclear Forces ; (iii) Theory of the Deuteron ; (iv) Theory of H^3, He^3 and He^4 ; (v) Statistical Theory of Nuclei ; (vi) More Detailed Theory of Heavy Nuclei ; (vii) β-disintegration and Nuclear Forces ; (viii) Nuclear Moments.

2930. Constitution of Metallic Potassium. E. Gorin. *Phys. Zeits. d. Sowjetunion,* 9. 4. *pp.* 328–344, 1936. *In English.*—A treatment of the binding in metallic potassium is presented following the method of Wigner and Seitz. The Hartree field is used and the interactions of the metallic electrons with the inner shell electrons explicitly computed. A calculation of the ionisation potential of the atom with the Hartree field gives 0·393 Rydberg units as against the experimental value 0·319. The binding energies obtained with the Hartree field are accordingly corrected to a field of the proper depth. The metallic wave functions are found to be nearly exponential for the lattice distances 5·34 and 5·47 Bohr units. The wave functions for smaller lattice distances deviate very considerably from the exponential form and the Wigner-Seitz method gives bad results. The final results are binding energy 20·4 k.cal. and lattice constant 4·80 Å and the experimental values 22·6 k.cal. and 5·20 Å respectively. The importance of a revision of the method for non-exponential wave functions is indicated. [See Abstract 1309 (1935).] AUTHOR.

2931. Nuclear Spectra of Light Atoms. W. Bothe. *Zeits. f. Physik,* 100. 5–6. *pp.* 273–285, 1936.—The γ-radiation emitted from Li, F and Be when bombarded with α-particles is analysed by examining the spectrum of the β-particles it expels from Pb. Li gives at least two lines, probably due to Li^7; F gives one line (probably due to F^{19}) and another probably due to a transition product of F; Be shows three lines. The significance of the results and the possibilities of the experimental method are discussed. J. E. R. C.

2932. Excitation of the $^{17}_{8}O$ Nucleus. G. Stetter. *Zeits. f. Physik*, 100. 9–10. *pp.* 652–655, 1936.—Experiments on the disintegration of N with RaC′ give two energy levels of $-1{\cdot}4 \times 10^6$ and $-2{\cdot}8 \times 10^6$ eV. The difference corresponds to the energy of a weak γ-ray actually observed in N disintegration experiments. One also finds agreement with the energy differences which appear in the disintegration of Ne with neutrons and which also concern $^{17}_{8}O$ by rearranging Jaeckel's results [see Abstract 4042 (1935)]. From these nuclear processes the masses of $^{17}_{8}O$ and $^{20}_{10}Ne$ are calculated to be 17·0046 and 19·9995 respectively. J. E. K.

2933. Boron Disintegration with Slow Neutrons. M. J. Deisenroth-Myssowsky, G. D. Latyschev, L. I. Russinov and R. A. Eichelberger. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences*, 1. 9. *pp.* 351–353, 1936. *In German*—Using a Wilson chamber of dia. 25 cm. containing $B(CH_3)_3$, the disintegration of B by slow neutrons produced by a Ra-Be source of 200–300 mc. situated in water at a distance of 67 cm. from the centre of the chamber was examined. One disintegration was obtained in every two or three expansions. The curve, each point of which corresponded to 1000 disintegrations, connecting number of disintegrations and thickness of water layer shows a rapid rise to a maximum at 8–10 cm. of water after which continual decrease is observed. F. C. C.

2934. Disintegration of Boron by Neutrons. R. J. Walen. *Comptes Rendus*, 202. *pp.* 1500–1502, *May* 4, 1936.—A thin layer of B spread on Pb was placed either at varying distances from a Au window of a Wilson chamber, or on the inside wall thereof, and bombarded with neutrons from Po + Be surrounded by paraffin. The results point to disintegration according to $^{10}_{5}B + ^{1}_{0}n \rightarrow ^{7}_{3}Li + ^{4}_{2}He + Q_1$, with paths $R_{Li} = 3 \pm 0{\cdot}5$ mm., and $R_{He} = 8{\cdot}5 \pm 0{\cdot}3$ mm., energies $E_{Li} = 0{\cdot}9$, $E_{He} = 1{\cdot}5 \pm 0{\cdot}3$ eMV, and $Q_1 = 2{\cdot}35$ eMV [see Abstract 2326 (1935)]. But $Q_1 = Q_2 - Q_3$, where $^{9}_{4}Be + ^{2}_{1}H \rightarrow ^{7}_{3}Li + ^{4}_{2}He + Q_2$, or $\rightarrow ^{10}_{5}B + ^{1}_{0}n + Q_3$, where $Q_2 = 7{\cdot}2$ eMV and $Q_3 = 4{\cdot}12$ eMV [see Abstracts 2331 and 2790 (1935)]. The present results give $Q_3(= Q_2 - Q_1) = 4{\cdot}85$. The difference (0·73) from 4·12 is explained by emission of photons of energy 0·7 eMV [see Abstract 3219 (1935)]. C. A. S.

2935. Disintegration of Li^7 Bombarded by Slow Protons. H. D. Doolittle. *Phys. Rev.* 49. *pp.* 779–782, *June* 1, 1936.—The number of Li^7 atoms disintegrated by protons of energies from 23·6 to 72·5 ekV is determined. Oppenheimer's integration of Gamow's equation giving the probability of the lithium-proton disintegration as $n = bVe^{-a/V^{\frac{1}{2}}}$ is compared with the experimental data by plotting log n − log V against $1/V^{\frac{1}{2}}$. The agreement is within the experimental error. The results of the present experiment are compared with other observers' data taken at higher voltages; the slopes of the lines are found to vary somewhat. No indications of resonance nor of a minimum voltage required for disintegration are observed. Considerable difficulty is encountered as regards surface contamination of the target and also the formation of a highly insulating layer of lithium oxide. The latter effect made necessary the frequent use of a Faraday chamber for recording the proton current. An FP-54 pliotron in a modified form of the DuBridge-Brown balanced circuit was used in photographic recording of the α-particles. AUTHOR.

2936. Variation of Range with Angle of the Disintegration α-Particles of Li^7. A. Roberts, T. Zandstra, R. Cortell and F. E. Myers. *Phys. Rev.* 49. *pp.* 783–788, *June* 1, 1936.—The range of the α-particles emitted from Li^7 under 200 and 240 kV proton bombardment is measured at various angles with respect to the incident beam of protons. The results are fully in accord with the predictions of the principles of conservation of energy and momentum when the straggling due to the penetration of the target by the proton beam is taken into account. The results show, furthermore, that if ${}_4Be^8$ is formed in this reaction, and subsequently disintegrates into two α-particles without the emission of a γ-ray, it must have a mean life of not more than 3×10^{-4} sec. AUTHORS.

2937. Transmutation of Platinum by Deuterons. J. M. Cork and E. O. Lawrence. *Phys. Rev.* 49. *pp.* 788–792, *June* 1, 1936.—The radioactivity induced in Pt by 5 eMV deuterons is composite in character. Chemical separations of the active elements together with an analysis of the decay curves establish that at least two radioactive isotopes each of Ir and Pt are formed. The decay periods of the former are about 28 min. and 8·5 hr. while the latter have periods in the neighbourhood of 49 min. and 14·5 hr. Inasmuch as the Pt activity emits both positrons and electrons it seems reasonable to ascribe the activities to the isotopes Pt^{193} and Pt^{197} resulting from neutron capture. The active Ir isotopes are probably formed in reactions involving deuteron capture and α-particle emission, and the likely radioactive isotopes are Ir^{194} and Ir^{196}. The transmutation functions for the reactions leading to Ir isotopes exhibit maxima indicative of resonance penetration of the Pt nucleus by the deuteron; the nature of the transmutation functions for the reactions giving Pt isotopes is not made certain by these experiments, because of the relative weakness of the Pt activities. AUTHORS.

2938. Artificial Radioactivity. K. Diebner and E. Grassmann. *Phys. Zeits.* 37. *pp.* 359–383, *May* 15, 1936.—Comprehensive account of artificial radioactivity in six parts dealing with the results obtained by using α-particles, protons, deuterons, neutrons, electrons and γ-rays as bombarding agents. A Bibliography of 187 papers is appended. F. C. C.

2939. β-Ray Spectra of Slow-Neutron-Activated Substances. E. R. Gaerttner, J. J. Turin and H. R. Crane. *Phys. Rev.* 49. *pp.* 793–797, *June* 1, 1936.—In, Ag, Rh, Mn and Dy are rendered radioactive by exposure to slow neutrons from a 200 millicurie Rn-Be source surrounded by paraffin, and their β-ray spectra obtained by the cloud-chamber method. The plots of the energy distributions are transformed into straight lines according to the Konopinski-Uhlenbeck formula, and extrapolated to find the upper energy limits. The fit with the K-U theory is found to be good. The extrapolated upper energy limits found are: In (54-min. period), 1·3; In (13-sec. period), 3·2; Ag, 2·8; Rh, 2·8; Mn, 2·8; Dy, 1·4 eMV. AUTHORS.

2940. Radioactivity Produced in Tantalum by Neutron Bombardment. V. Fomin and F. G. Houtermans. *Phys. Zeits. d. Sowjetunion*, 9. 2–3. *pp.* 273–274, 1936. *In German.*—The feeble radioactivity produced in Ta by neutron bombardment has a period of 200 ± 100 d. The intensity produced per hour in Ta is about 10^{-5} the saturation intensity of Ag and the β-rays emitted are extremely soft. Long periods are characteristic of elements in this region of the periodic table, those for Ir and Lu being two months and six days respectively. F. C. C.

2941. Activity of Various Substances on Bombardment by Slow Neutrons. L. I. Rusinov and G. D. Latyshev. *Phys. Zeits. d. Sowjetunion,* 9. 4. *pp.* 287–301, 1936. *In English.*—According to the theory of Perrin, Elsasser and Bethe [see Abstracts 1306 and 2790 (1935)] the effective cross-sections of all elements for the capture of slow neutrons vary inversely as the velocity of the neutrons. This conclusion from theory was tested by studying the increase in the artificial radioactivity of several elements on increasing the thickness of the retarding water layer. The experiments show that the relative increase in artificial radioactivity is different for different indicators. Bethe's theory, according to which the relation between σ and E should be the same for all elements, is not corroborated. AUTHORS.

2942. Separation of Gas Mixtures by Diffusion into Streaming Mercury Vapour. H. Barwich. *Zeits. f. Physik,* 100. 3–4. *pp.* 166–191, 1936.—The efficiency of separation obtainable with pumps of the type described by Hertz [see Abstract 15 (1935)] is investigated both theoretically and experimentally and the most advantageous working conditions are determined. The dependence of degree of separation upon time is also calculated for an assembly of a number of pumps. Experiments carried out with a battery of 48 pumps give separation of Ne^{20} and Ne^{22} in $2\frac{1}{2}$ hr. as indicated by spectroscopic observation of hyperfine structure. However, when the same arrangement is used for the separation of H_2O^{16} and H_2O^{18}, for which the separation factor should be approximately the same as for the neon isotopes, the concentration of H_2O^{18} (detected mass-spectrographically) can only be raised to 10 % of the concentration of H_2O^{16} after 75 hr. It is concluded that this low efficiency must be ascribed to rapid exchange with the water film on the surface of the glass apparatus. L. A. W.

2943. Photochemical Separation of Mercury Isotopes. K. Zuber. *Helv. Phys. Acta,* 9. 4. *pp.* 285–300, 1936. *In German.*—When a mixture of Hg vapour and O_2 is irradiated with the resonance line 2537 Å of Hg there takes place oxidation of the Hg. Since the oxide is only produced after previous excitation of the Hg atoms Mrozowski proposed the excitation of individual isotopes so that if the reaction consists only of the photochemical primary process $Hg^* + O_2 = HgO + O$ the oxide should only contain the particular previously excited isotopes [see Abstract 238 (1933)]. Separation of the isotopes of Hg is attempted by this method and it is found that the mixture Hg and O_2 is not suitable for a separation and that some N_2 must be added. The separation is always found to be only partial as a result of secondary reactions. Improved separation is obtained from a repeat experiment samples being obtained in which the ratio of the individual isotopes differed by a factor of four. [See also Abstract 4766 (1935).] J. E. K.

2944. Isotope Effect in the Evaporation of Lithium, Potassium and Rubidium Ions. A. K. Brewer. *J. Chem. Phys.* 4. *pp.* 350–353, *June,* 1936.—Abundance ratio measurements are necessarily complicated by the possibility of an isotope effect at the source. In the emission of positive thermions of Li, K and Rb the extent to which the ion ratio represents the atom ratio within the source can be estimated by observing the change in the abundance ratio as a function of the percent of alkali evaporated. In the case of Li an initial ratio of $Li^7/Li^6 = 11{\cdot}60$ was observed; the abundance ratio followed the computed ratio for ideal evaporation until the Li was 40 % exhausted, beyond which it fell below

the ideal value. The abundance ratios of $K^{39}/K^{41} = 14{\cdot}22$ and $Rb^{85}/Rb^{87} = 2{\cdot}59$ remained almost unchanged during the process of exhaustion. It is apparent therefore that a correction factor needs to be applied to the ion abundance ratio for Li, but is unnecessary for K and for Rb. The atomic weights computed from the abundance ratios are Li = 6·939, K = 39·094 and Rb = 85·46. [See Abstract 1402 (1936).]
AUTHOR.

2945. Absorption of Slow Neutrons. E. Amaldi and E. Fermi. *Ricerca Scientifica*, 1. 1–2. *pp.* 56–59, *Jan.*, 1936.—Continuing work [see Abstract 3236 (1935)] on the groups of slow neutrons emitted from a Ra-Be source, the diffusion of the groups is examined experimentally and compared with theory. To account for the groups various hypotheses are put forward, one of the most favoured being that the neutrons differ not merely in velocity but are in different states of excitation. Collision with H nuclei appears to transform one group into another, the final state being group C where the neutrons have thermal energy. [See following Abstract.] F. C. C.

2946. Neutron Diffusion. Parts I and II. B. Pontecorvo and G. C. Wick. *Ricerca Scientifica*, 1. *pp.* 134–137, *Feb., and pp.* 220–222, *March*, 1936.—Using varying order of linear arrangement of Ra-Be source, paraffin wax block, detector, Cd layer and diffusing layer, the characteristics of groups C, D and I of slow neutrons are examined. Reflection and absorption experiments with diffusers of Al, Cu, Ag, Cd, Au, Mg, Fe, Ni, Zn, Sn, Hg and Pb show very similar behaviour for groups C, D and I, in contrast with their behaviour when H-containing diffusers are used [see preceding and following Abstracts]. The results are considered to support the contention that the difference in the neutron groups is one of excitation as well as velocity. F. C. C.

2947. Mean Free Path of Slow Neutrons in Paraffin Wax. E. Amaldi and E. Fermi. *Ricerca Scientifica*, 1. *pp.* 223–225, *March*, 1936.—Using an Ra-Be source enclosed in a paraffin wax block which was in turn enclosed in a Cd sheet of 0·5 gm./cm.^{2}, observation was made of the variation in the activation of a Rh detector with distance from a window (which could be opened or closed) in the Cd sheet, when layers of paraffin wax were interposed between source and detector. The absorption followed an exponential law of the form $e^{-x/\lambda}$, where λ was the mean free path of the neutrons present which were those of thermal energy (group C). These results, combined with theoretical considerations, establish the following characteristics of the group C neutrons : (1) in paraffin $\lambda = 0{\cdot}15$ cm., (2) number of collisions before capture = 500, (3) cross-section for elastic collision and capture respectively $= 86 \times 10^{-24}$ cm^2. and $0{\cdot}17 \times 10^{-24}$ cm.^{2}, (4) average life $= 3{\cdot}8 \times 10^{-4}$ sec. The mean free path of the group C neutrons in H_2 is considerably less than the average for all the groups present. [See preceding and following Abstracts.]
F. C. C.

2948. Groups of Slow Neutrons. E. Amaldi and E. Fermi. *Ricerca Scientifica*, 1. *pp.* 310–313, *April*, 1936.—Using a method based on the diffusion of neutrons in different absorbers [see preceding Abstract], the velocities of the groups D, A, B and I of neutrons emitted by an Ra-Be source were determined. The mean free path in H_2 is about 0·65 cm. and is of the same order for all the groups. The logarithmic intensities of the groups D, A and I are in the ratio 0·8, 0·06 and 0·2, while the energies of groups D, A + B and I are in the ratio 1 ; 11 ; 400. F. C. C.

2949. Selective Absorption of Neutrons. I. Kurtschatow and G. Shchepkin. *Phys. Zeits. d. Sowjetunion*, 9. 1. *pp*. 102–105, 1936. *In English*.—The selective absorption of neutrons was first discovered by Tillman and Moon [see Abstract 376 (1936)]. Their conclusions have recently been confirmed by Amaldi and Fermi who, employing as their neutron source a bulb with Rn + Be, surrounded by a thick layer of paraffin wax, measured the absorption coefficient of a neutron for a number of elements with beams of varying energy distribution, the neutrons being absorbed in Cd. Szillard has examined the phenomenon independently and his conclusions agree with those of Amaldi and Fermi. There is a region of selective absorption and in the present paper the authors examine its energy limits by determining the activity of Ag as a function of the thickness of the layer of paraffin wax for different filtrations of the beam. Details of the experiments are given. The neutrons were obtained by the disintegration of Be by the γ-rays of radon and its decomposition products. The strongly absorbed radiation has energy of thermal order whilst the weakly absorbed occupies a region of higher energy. Moreover, (1) the absorption coefficient in Ag of the hard component is greater than that of the soft component, and (2) the absorption coefficient is greatest for neutrons which have suffered practically no retardation. The energies of the neutrons from the source used were between 2 and 5×10^5 eV. Thus the region of selective absorption lies between 10^4 and 10^5 eV. J. J. S.

2950. Passage of Neutrons through Matter. C. H. Collie and J. H. E. Griffiths. *Roy. Soc., Proc.* 155*A*. *pp*. 434–446, *June* 2, 1936.—The passage of neutrons through matter is investigated under conditions which enable true absorption coefficients to be measured independently of scattering. Using Al and Si detectors absorption cross-sections ($1 - 1{\cdot}4 \times 10^{-24}$ sq. cm.) are obtained which do not increase systematically with increasing atomic number. Using I and Ag as detectors, the presence of the absorbing material is found to produce an increase in the activity with all the elements examined except S and I. A simple hypothesis to account for the phenomena is put forward. AUTHORS.

2951. Wave-Length Dependence of Nuclear Photo-Effect of Beryllium. R. Fleischmann and W. Gentner. *Zeits. f. Physik*, 100. 7–8. *pp*. 440–444, 1936.—The relative yields of neutrons released from Be by γ-radiation from Ra and Ra Th is determined and found to be $1 : 0{\cdot}873$. J. E. R. C.

2952. The Neutron. K. E. Corrigan. *Am. J. of Roentgenology and Radium Therapy*, 35. *pp*. 543–548, *April*, 1936.—A review of modern conceptions of atomic physics. Possible applications of artificial radioactive products, in respect to therapeutic modification of physiological metabolism as in thyroid disorders and their injection into neoplasm for therapeutic purposes, are foreshadowed. B. J. L.

2953. Orbital Valency and Directional Properties in the Theory of Chemical Union. Parts I and II. Gertrud Nordheim-Pöschl. *Ann. d. Physik*, 26. 3. *pp*. 258–280 *and* 26. 4. *pp*. 281–307, *June*, 1936.—This consideration of chemical union (spin valency) based on an extension of the original Heitler-London theory commences with a study of diatomic molecules, treated under the following headings: (1) The Heitler-London theory of di- and polyatomic molecules; (2) Extension of the theory. Ground state of C_2. Spin function product; (3) Orbital valency. Qualitative term schemes for C_2 and O_2; (4) Term scheme for N_2 and ground state of F_2, CN, NO, BO, CO. Polyatomic molecules are then considered under Part II as follows: (5) Bond energies and directional properties of CH_2, CH_3, CH_4; molecular models, spin functions, tetrahedral stability, and the theory of bond energy; (6) The hydrocarbons C_2H_2, C_2H_4, C_2H_6. Restricted rotation of the double bond; molecular models; degree of degeneration of the secular equations; semi-classical theory. Throughout the paper the theory is systematically developed and illustrated by characteristic examples. An Appendix contains a table of all the integrals obtained. H. H. Ho.

2954. Theory of Metallic Bond. Part II. P. Gombás. *Zeits. f. Physik*, 100. 9–10. *pp.* 599–614, 1936.—This work continues a previous investigation [see Abstract **2482** (1936)] and amplifies the statistical model for metals then proposed, whereby for ions, which are to be corrected for electronic exchange, the Thomas-Fermi-Dirac statistical distribution function was fundamentally utilised. By this means a useful computation has been made of the energy changes involved in the reciprocal exchanges between the metal-electrons and the atomic residues. While the object of the earlier work was to obtain the most exact calculation possible of the lattice energy and of the lattice constant, the present paper includes a similar exact evaluation of the heat of sublimation. The formulæ derived have been employed for the calculation of the most important constants of metallic K, Rb and Cs. The calculations are very simple in character, do not involve numerical integrations, and are in satisfactory agreement with the experimental data. Finally it is shown that for K the results can be somewhat improved by certain plausible assumptions. No empirical or semi-empirical parameters have been introduced into the calculations. H. H. Ho.

2955. Number of Isomers of Chemical Compounds. G. Pôlya. *Comptes Rendus*, 202. *pp.* 1554–1556, *May* 11, 1936.—The author shows how to derive the numbers of isomers (neglecting stereoisomers) for the paraffins, alcohols, unsaturated hydrocarbons, substituted paraffins, and benzene derivatives, which are found to be asymptotically proportional to given factors. H. H. Ho.

***2956. Determination of Molecular Structure by Electron Diffraction. P. G. Ackermann and J. E. Mayer.** *J. Chem. Phys.* 4. *pp.* 377–381, *June*, 1936.—An apparatus has been designed and built for the purpose of determining molecular structure by electron diffraction using 6400-V electrons. The apparatus was checked with CCl_4 whose structure is accurately known, and the interatomic distances and configurations of a number of compounds were determined. Ethylene oxide was found to be a 3-membered ring with a C-C distance of 1·56 ± 0·05 Å, a C-O distance of 1·45 ± 0·05 Å and a C-H distance of 1·05 ± 0·07 Å. SCl was found to have the two Cl atoms attached to different S atoms, the S-S distance was found to be 2·04 ± 0·05 Å, the S-Cl distance of 1·98 ± 0·05 Å and an angle of 105 ± 5° between bonds. In acetaldehyde the C-O distance was found to be 1·20 ± 0·05 Å, the C-C distance 1·51 ± 0·05 Å and the bond angle 122 ± 5°. Paraldehyde was found to have a puckered ring structure with a C-O distance of 1·41 ± 0·05 Å, a C-C distance of 1·52 ± 0·05 Å and the tetrahedral angle of 109° between bonds. AUTHORS.

2957. Atomic Weights by Calculation. A. C. Woodmansey. *Phil. Mag.* 21. *pp.* 1079–1081, *June*, 1936.—The development of our knowledge of atomic structure is marked by a series of attempts to assert, disprove, and explain divergences from the "whole number rule." The author submits a method which provides calculated atomic weights in close agreement with those experimentally determined and without recourse to energy factors. Whatever the explanation may be, it certainly appears that the weight of any atom may be represented by the expression $xn + y\mathrm{E}$, where x is the mass number, y the atomic number, and n and E are constants. H. H. Ho.

See also Abstracts **2993**, **3131**, **3204**, **3205**, **3264**, **3300**.

COLLOIDS.

2958. Electrolytic Coagulation of Weak Solvated Sols and Electrolytic Activity. Part II. Wo. Ostwald. *Kolloid Zeits.* 75. *pp.* 39–59, *April,* 1936.—Available numerical data on the influence of the concentration (c) of the sol on the flocculation value (m_K) of neutral salts by weak solvated sols are brought together and coordinated and it is shown that there are three groups of m_K, c-functions. [For Part I see Abstract 945 (1936).] J. K.

2959. Cataphoretic Velocity in Inorganic Colloids. J. N. Mukherjee, S. G. Chaudhury and B. N. Ghosh. *Kolloid-Beihefte,* 43. 12. *pp.* 417–466, 1936.—The history of the subject is fully traced and the meaning of cataphoretic velocity defined. The relationship of cataphoretic velocity to stability and colloidal aggregates, to the primary adsorption layer, to dilution, to non-electrolytes, and electrolytes and their mixtures, to the critical potential, etc., are each treated fully and separately. The paper is illustrated by calculations from numerical values. Two aspects are considered. (1) According to the theory of Helmholtz-Smoluchowski the cataphoretic velocity is dependent upon the potential of the double layer, the dielectric constant, and the viscosity of the medium, but is independent of the size and disposition of the particles. Thus the potential is a function of the capacity of the double layer and the surface charge density of the particles. The present paper shows that the surface charge is the most important factor (2) According to Duclaux, Michaelis Pauli and McBain, colloids are treated as a particular class of electrolytes with macroscopic ions. According to their theory the velocity is proportional to the total charge of the particles or micelles and is inversely proportional to the particle radius. The present experimental results do not agree with their views and the Helmholtz-Smoluchowski theory is upheld. The apparent disagreement with the second theory is accounted for and discussed. S. G. B.

2960. Heat Generation and Anisotropy of Rubber Compounds in the Flexometer. R. S. Havenhill. *Physics,* 7. *pp.* 179–188, *May,* 1936.—Data are given showing that it is possible for rubber to soften in one direction and stiffen in another direction simultaneously during a test in the St. Joe flexometer. Both effects are mainly the result of heat, the softening being due to plastic flow, while the stiffening is due to the substantial elimination of plastic flow because of the rapidity of flexure. Static and dynamic tests on heated test pieces, and stress-strain data on various sections of test specimens at several stages of breakdown indicate that failure in dynamic tests is due partially to mechanical fatigue, but mainly to heat effects. Results on anisotropic pigments such as asbestine, clay, magnesium carbonate, and acicular and non-acicular zinc oxides show that the heat generation, breakdown time, flexing load, and vertical deflection are functions of the shape and orientation of the pigment particles. Variations in breakdown time from 16 to 160 minutes have been obtained by changing the orientation of pigment particles. Data on " grain " effect in high gum stocks are also given. AUTHOR.

2961. Effect of Pigment Particle Size on Physical Properties of Rubber Compounds. C. E. Barnett. *Physics,* 7. *pp.* 189–194, *May,* 1936.—The stresses around large obstacles in strained rubber are studied with the assumption that the effects will be similar with actual pigment particles. The effects of variations in the size and shape of the obstacles on the stress concentration are investigated and an explanation is offered for the stiffening of rubber by pigments based on the change in slope of the rubber stress strain curve. The various average diameters of a series of zinc oxide samples are measured and their relationship with some physical properties of rubber compounds determined. AUTHOR.

2962. Dynamical Principle of Thixotropic Solidification and its Application. W. Heller. *Comptes Rendus,* 202. *pp.* 1507–1509, *May* 4, 1936.—The elasticities of a fluid merely viscous, E_1, of one permanently thixotropic E_2, and of a permanent gel, E_3, when plotted against time show steady increases to limits. E_3 liquids, *i.e.*, those forming permanent gels, may be transitorily thixotropic (exhibit " intermediate thixotropy ") until the elasticity has increased above the E_2 limit. This is the case with gelatin. Experiments show that such gels may show permanent thixotropy, which may be due to diminution of elasticity with increased concentration, with rise in temperature, or on addition of an electrolyte (*e.g.*, HCl, KOH, NaCl), or of EtOH or acetone with or without an electrolyte. [See Abstract 953 (1936).] C. A. S.

2963. Liesegang Rings of Manganese Sulphide. O. F. Tower. *J. Phys. Chem.* 40. *pp.* 599–602, *May,* 1936.—A method for obtaining Liesegang rings in silica gel is described. MnS bands in silica and other gels are spaced approximately in geometrical progression, the multiplier having the average value of 1·21. Although in general the bands of MnS are formed by a process of diffusion essentially in accord with Hughes' theory, the time of formation of the bands is considerably influenced by supersaturation and adsorption. [See Abstract 3614 (1931).] AUTHOR.

2964. Analyses of Liesegang Rings. A. T. Lincoln and J. C. Hillyer. *J. Phys. Chem.* 40. *pp.* 645–647, *May,* 1936.—By quantitative analyses of rhythmically banded copper chromate structures in silicic acid gel it is shown that, while the copper and the sulphate ions are distributed throughout the tube in a manner to be expected from simple diffusion, there are present in the lower clear space both copper and chromate ions in moderate concentration. Copper chromate is found to precipitate when the ions are present in the concentrations found in these spaces, even in the presence of the same amount of free acetic acid and of sodium acetate present in these gels. It appears that the presence of silicic acid inhibits the precipitation of this compound until higher concentrations are reached, and so aids in the formation of banded structures. AUTHORS.

2965. Effect of Surface Tension and Electrical Potential on Stability of Mercury Emulsions. V. Sivertz, W. H. Naylor and H. V. Tartar. *Am. Chem. Soc., J.* 58. *pp.* 782–786, *May,* 1936.—The interfacial tension γ against Hg of water and a number of salt solutions was measured by the capillary-rise method. For the solutions studied, when pH > 7, γ is greater than the value 374·8 found for a pure water interface, and when pH < 7, γ is less than this. The interfacial tension, and the pH of the solution have no direct bearing on the emulsification of Hg. Emulsifying and non-emulsifying agents give electrocapillary curves similar in maxima and form. When a W electrode in the solution is connected to the Hg γ is less than for a pure water Hg interface. P. H. B.

2966. Colour and Opacity of Emulsions. J. F. Morse. *Faraday Soc., Trans.* 32. *pp.* 941–947, *June*, 1936.—An investigation is made relating to the opacity of emulsions as influenced by the factors of concentration and grain-size of the internal phase. A photoelectric photo-colorimeter and six spectrum filters are employed to determine (*a*) the effect of grain-size on the tone of a coloured emulsion; (*b*) the opacity of emulsions of varying grain-size and volume-ratio. Emulsions of very fine grain, about 1 μ dia., contained in a 1 cm. deep cell, exhibit equal opacities when the concentration ranges from 5 % and upwards. Added oil-soluble or water-soluble colouring matter does not affect this result. AUTHOR.

***2967. Electrophoresis Cell for Microscopic Observations. M. E. Smith and M. W. Lisse.** *J. Phys. Chem.* 40. *pp.* 399–412, *March*, 1936.—A description, theory, and theoretical advantages of the new cell are given. It consists of two tubes in parallel between the electrodes, the dimensions of the tubes having a relation such that return flow takes place only through the tube of larger radius. There is no movement of the liquid along the axis of the tube of smaller radius, hence the velocities observed at the one-half depth in this tube are the actual electrophoretic velocities. Electrophoretic mobilities of finely ground quartz particles in triply distilled water obtained in this cell agreed, within experimental error, with values as determined in a single cylindrical tube. J. K.

2968. Silica Fluff. C. A. Jacobson. *J. Phys. Chem.* 40. *pp.* 413–418, *March*, 1936.—If the silicic acid obtained by the action of SiF_4 on water is dried at low temperatures, the resulting product is a form of hydrated silica possessing unusual properties. The light, fluffy, white powder is composed of aggregates of tiny flakes of irregular outline, containing inclusions of air bubbles of uniform size that give colour phenomena with polarised light. The specific gravity of the material is 1·018. J. K.

2969. Photographic Observation of the Particles of Aerosols. A. Winkel and W. Witt. *Zeits. f. Elektrochem.* 42. *pp.* 281–285, *June*, 1936.—Briefly describes an objective photographic method for the observation of aerosols formed of ultramicroscopic particles in which the particles are brilliantly illuminated from both sides by the light from 40-A hand-controlled arc lamps. Similar optical systems are used on either side of the aerosol, the viewing camera being arranged so that the light can be thrown on to a matt viewing screen or on to the photographic plate by means of a prism. Examples of the usefulness of the method are given by means of photographs illustrating the ultramicroscopic particles in tobacco smoke (1/10 sec. exposure) and the molecular movement of such particles, the sedimentation of a separation of MgO, the movement of MgO smoke particles between the parallel plates of a condenser connected to a l.f. a.c. supply, the simultaneous determination of charge and mass of particles, sedimentation using the parallel plate condenser, and the effect of a h.f. sound wave, this last indicating that the particles are capable of following this high frequency. [See Abstract 756 (1928).] R. C. F.

See also Abstracts **2998, 3020, 3051, 3056, 3057, 3063, 3064, 3065, 3281, 3282, 3334, 3335.**

CRYSTAL STRUCTURE AND PROPERTIES.

2970. Theory of Mobile Pores and Interstitial Atoms in Crystals. J. Frenkel. *Acta Physicochimica*, 4. 4. *pp*. 567–574, 1936. *In German.*—The main purpose is an extension of Schottky's work [see Abstract 4374 (1935)], with particular reference to kinetics of mobile pores in monatomic crystals. The statistical treatment of such pores, and dissociation, are discussed. It appears that the number of pores varies with temperature in the same way as the pressure of a saturated vapour. F. I. G. R.

2971. Matrix - Algebraic Development of Crystallographic Groups. Part IV. F. Seitz. *Zeits. f. Krist.* 94. *pp*. 100–130, *June*, 1936. *In English.*—The development of the remaining groups, C_4, S_4, C_4^h, C_4^v, V^d, D_4, D_4^h, C_6, C_3^i, C_6^h, D_6, C_6^v, D_3^d, D_6^h, T, T^h, T^d, O, and O^h is dealt with. [For Part III see Abstract 4067 (1935).] C. A. S.

2972. Crystal Structure and Ferromagnetism of Transition Metals. U. Dehlinger. *Zeits. f. Metallkunde*, 28. *pp*. 116–121; *Disc.*, 131–132, *May*, 1936.—The known relations between crystal structure and physical properties are briefly summarised. The fundamental laws of ferromagnetism are explained in terms of the electronic theory; this theory is used to calculate the values of magnetisation at saturation for the case of the transition elements. These values are compared with those observed and an explanation of the discrepancies between the two values in the case of Fe, Co and Ni is offered. The atomic moments and exchange intervals of the transition elements are given and are discussed from the viewpoint of the electronic theory. H. J. H. S.

2973. Structure of Electrodeposited Metals. G. I. Finch and C. H. Sun. *Faraday Soc., Trans.* 32. *pp*. 852–863, *June*, 1936.—The structure of electrodeposited and chemically displaced metal surfaces and films is studied by the method of electron diffraction. It is found that the structure of the substrate upon which a metal is electrodeposited nearly always profoundly affects that of the deposit, in that the orientation of the substrate crystals determines that of the deposit. In those few cases where the effect does not occur the deposit generally exhibits poor powers of adhesion. Anomalous diffraction effects, shown to be due to secondary elastic scattering, are obtained, and the bearing of this phenomenon on the interpretation of electron diffraction pattern intensities is discussed. It is shown that, unlike in electrodeposition, chemical displacement of one metal by another leads to the formation of an alloy. AUTHORS.

2974. Diffraction of Electrons by Amalgam Films. A. E. Aylmer, G. I. Finch and S. Fordham. *Faraday Soc., Trans.* 32. *pp*. 864–871, *June*, 1936.—Amalgams of Au, Ag and Cu and also the effect of Hg vapour on Pd leaf are studied by electron diffraction. It is found that Au and Ag readily form a wide variety of amalgam structures of which three are successfully analysed. Thus Au and Ag both form simple cubic amalgams with $a = 17 \cdot 81$ and $17 \cdot 94$ Å respectively; and two other Ag amalgams, both of face-centred tetragonal structure, have also been recognised. Cu also amalgamates readily, particularly during the chemical displacement of Hg, but the structure of the most characteristic amalgam thus formed has not been identified. Pd is only partially attacked by Hg. The occurrence and prevention of adventitious amalgamation during the electron diffraction examination and heat treatment of metallic specimens are discussed. AUTHORS.

2975. X-Ray Study of Zn and Cd Films Deposited in the Presence of Colloids. L. Palatnik. *Faraday Soc., Trans.* 32. *pp.* 939–941, *June*, 1936.—Films are formed in electrolytes containing 24 % $ZnSO_4$, 1·5 % $AlCl_3$, 3 % $Al_2(SO_4)_3$, 0·05 % H_2SO_4 at 2 and 5 A/*dm*². in the presence of 0–1·0 % dextrin; and 1·6 % CdO, 20 % KCN, at 0·75 and 1 A/*dm*². in the presence of 0·05–0·1 % dextrin or 0·01–0·1 sulphonated castor oil, or 0·025–0·1 % cereal extract. During the operation the colloid gradually disappears. By X-ray examination the bright films are shown to have crystals arranged perpendicularly to the kathode surface but the orientation is not perfect, particularly with Zn. [See Abstract 1096 (1928).] D. R. H.

2976. Structure of Aluminium Oxide Films by means of Electron Interference. E. Belwe. *Zeits. f. Physik*, 100. 3–4. *pp.* 192–196, 1936.—Deductions as to the structure of thin films of Al_2O_3 are drawn from observations of the interference of rapid electrons passed through them. Films produced by electrolytic oxidation are found to consist of very fine crystals of γ-Al_2O_3. Those produced by oxidising Al foil in a flame are found to consist of the same γ-oxide in the usual coarsely crystalline form, intermingled with thin single crystals of Al which give rise to interferences of the two-dimensional lattice type. Interference photographs are reproduced. L. A. W.

2977. Structure of Metallic Layers Condensed on Rock-Salt. L. Brück. *Ann. d. Physik*, 26. 3. *pp.* 233–257, *June*, 1936.—Thin metallic layers (of Ag, Au, Al, Cu, Co, Pd, Ni, Fe and Cr) were deposited upon rock-salt by evaporation of the metals *in vacuo* and their structure investigated both by transmitted and reflected electronic radiation. Above a definite temperature characteristic for each of the metals Au, Ag, Al, Ni, Cu and Pd, the condensed layer consists of a crystal mosaic-like picture composed of many small crystallites which are all similarly orientated and afford the refraction of a single crystal. The Co-, Fe- and Cr-layers, however, still possess at 540° C. (the highest temperature employed) no complete unit crystal structure. With Fe and Cr there occur three orientations simultaneously, but at high temperatures these tend to be parallel to the (001) of the rock-salt surface. The results for condensed metallic layers are in accord with those for crystallisation from solutions and extend the generalised orientation rule already established for the last named process. The orientation process for successive depositions is described at length with quantitative data, and the paper is replete with experimental details, illustrations and photographs. H. H. Ho.

2978. Diffraction of Electrons by Graphite. G. I. Finch and H. Wilman. *Roy. Soc., Proc.* 155*A*. *pp.* 345–365, *June* 2, 1936.—It is found that graphite powders give a number of diffractions which do not appear to fit in with the structure assigned by X-ray workers. These "extra" diffractions are shown to be due neither to impurities nor to dimensional lattice deviations at the crystal surface. Thin single crystals also give these "extra" diffractions, but thick crystals give Kikuchi patterns which agree completely with X-ray results. It is concluded that these "extra" diffractions obtained with thin crystals are due to the fact that the lattice, although virtually unbounded in the cleavage plane directions, is limited in other dimensions by the thinness of the crystal; the consequence is that diffractions of fractional l-index and diffractions normally forbidden by structure-factor considerations can occur. The lattice constants are determined in terms of that of gold. C. J. B. C.

2979. Structure of Ice. N. Seljakov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 1. 7. *pp.* 293–294, 1936. *In English.*—From Laue photographs it is concluded that two forms of ice exist, one hexagonal in symmetry and the other rhombohedral. The first is formed when the temperature is somewhat below zero and the second when there is a considerable frost. J. T.

2980. Structure of Barium Antimonate. J. Beintema. *K. Akad. Amsterdam, Proc.* 39. 5. *pp.* 652–661, 1936.—Crystals of barium antimonate have the composition: $Ba(SbO_3)_2 + 8H_2O$ or $Ba\{Sb(OH)_6\}_2 + 2H_2O$. They are monoclinic prismatic (pseudo-orthorhombic). The dimensions of the body-centred elementary cell are: $a_0 = 9{\cdot}961$ Å; $b_0 = 12{\cdot}506$ Å; $c_0 = 10{\cdot}129$ Å; $\beta = 87° 17'$. The O-atoms probably form an approximately hexagonal closest-packing, from which at certain intervals each time a pair of O-atoms is substituted by a Ba-atom, whilst the Sb-atoms are situated in the intervening spaces of the close-packed structure; they are surrounded by six O-atoms, forming together the ions: $\{Sb(OH)_6\}'$. AUTHOR.

2981. Structure of Anhydrous Sodium Chromate, Na_2CrO_4. J. J. Miller. *Zeits. f. Krist.* 94. *pp.* 131–136, *June*, 1936. *In English.*—Anhydrous sodium chromate is built upon the holohedral type of the simple orthorhombic lattice. It belongs to the space group $V_h^6 - Pbnn$. The unit cell, containing four molecules of Na_2CrO_4, has the dimensions: $a = 5{\cdot}91$, $b = 9{\cdot}23$, $c = 7{\cdot}20$ Å. The four Cr atoms are in the special positions: $\pm(\frac{1}{4}, v, \frac{1}{4}) \pm (\frac{1}{4}, \frac{1}{2} - v, \frac{3}{4})$ with $v = 35°$. The eight Na atoms are in two sets of special positions. One group of Na atoms occupies the special positions $\pm(\frac{1}{4}, v, \frac{1}{4}) \pm (\frac{1}{4}, \frac{1}{2} - v, \frac{3}{4})$ with $v = 162°$; the other group occupies the special positions $\pm(u, \frac{1}{4}, 0) \pm (\frac{1}{2} - u, \frac{1}{4}, \frac{1}{2})$ with $u = -90°$. The sixteen O atoms, which surround the Cr atoms tetrahedrally at an average distance of 1·6 Å, occupy two sets of general positions $\pm(xyz) \pm (x, \frac{1}{2} - y, -z) \pm (\frac{1}{2} - x, y, \frac{1}{2} - z) \pm (\frac{1}{2} - x, \frac{1}{2} - y, z + \frac{1}{2})$ with the following parameters: $x_1 = 10°$, $y_1 = 72°$, $z_1 = 90°$, $x_2 = 90°$, $y_2 = 0°$, and $z_2 = 25°$. AUTHOR.

2982. Structure of K_2OsCl_6 and K_2OsBr_6. J. D. McCullough. *Zeits. f. Krist.* 94. *pp.* 143–149, *June*, 1936. *In English.*—From Laue and oscillation photographs it is deduced that K_2OsCl_6 and K_2OsBr_6 have the same structure as $(NH_4)_2 PtCl_6$. The unit cube of K_2OsCl_6 is $9{\cdot}729 \pm 0{\cdot}02$ Å, and that of K_2OsBr_6 is $10{\cdot}30 \pm 0{\cdot}03$ Å. The atomic parameters are determined. J. T.

2983. Structure of K_2ReCl_6. B. Aminoff. *Zeits. f. Krist.* 94. *pp.* 246–248, *June*, 1936.—Space-group O_h^5, $a = 9{\cdot}861 \pm 0{\cdot}003$ Å, with the potassium platinochloride structure, $u = 0{\cdot}240$. The radius of $Re^{4+} = 0{\cdot}56 \pm 0{\cdot}04$ Å. F. I. G. R.

2984. Structure of Ammonium Azide, NH_4N_3. L. K. Frevel. *Zeits. f. Krist.* 94. *pp.* 197–211, *June*, 1936. *In English.*—The cell dimensions of the orthorhombic crystal ammonium azide, with four molecules to the unit, were determined from X-ray data: $a_0 = 8{\cdot}930 \pm 0{\cdot}003$ Å, $b_0 = 8{\cdot}642 \pm 0{\cdot}003$ Å, $c_0 = 3{\cdot}800 \pm 0{\cdot}002$ Å. Density determinations of the substance gave a consistent value of 1·352 gm./cm³. On the basis of oscillation data and sublimation figures the space group $D_{2h}^7 - Pman$ was selected and the atomic positions were evaluated from intensity comparisons. Each ammonium nitrogen is bridged tetrahedrally (107°, 108·5°, 108·5°, 108·4°, 108·4°, 115·5°) by hydrogen bonds to four end-nitrogens of four N_3^- groups: two $(N^-)_I$ at a distance of 2·991 ± 0·026 Å and two $(N^-)_{II}$ at 2·942 ± 0·028 Å; and each terminal nitrogen is attached to two ammonium nitrogens (the bond angles for the two non-equivalent $(N^-)_I$ and $(N^-)_{II}$ being 138° and 99° respectively) and to the central nitrogen of the linear N_3^- group. The N—N separation in the azide ion was found to be 1·165 ± 0·021 Å.

AUTHOR.

2985. Structure of Silver Uranyl Acetate. I. Fankuchen. *Zeits. f. Krist.* 94. *pp.* 212–221, *June,* 1936. *In English.*—Silver uranyl acetate, $Ag(UO_2)(OAc)_3 \cdot ?H_2O$, is tetragonal, *a* 12·98, *c* 28·10 Å, *d* 3·1, 16 molecules in the unit cell, space group $C_{4h}^6 - I4_1/a$. Each U atom has 3 Ag around at U – Ag = 4·75, 4·74 and 4·36 Å. Each Ag has 3 U around it not quite in the same plane as it, giving a pseudo-cubic symmetry resembling that of cubic $Na(UO_2)(OAc)_3$, of the structure of which that of the Ag salt is a distorted version. Each Ag has three pairs of O atoms around it, the O's lying between the U atoms, each U is surrounded by six (OAc) groups, the six O's of which with the two of UO_2 form a distorted cube around each U. C. A. S.

2986. Structure of Cadmium and Mercury-Diammine-Dihalides. C. H. MacGillavry and J. M. Bijvoet. *Zeits. f. Krist.* 94. *pp.* 231–245, *June,* 1936.—The halogen and NH_3 in these compounds form a distorted CsCl lattice, with Cd or Hg placed in line between two NH_3 groups. F. I. G. R.

2987. Internal Transformations in the SO_3 System. Part I. A. Smits and N. F. Moerman. *Zeits. f. phys. Chem.* 32. *Abt.B.* 5. *pp.* 369–382, 1936.—The vapour pressure curve against time for the perturbed α-form of SO_3 is hyperbolic. For the same state the molecular heat of fusion is found to be – 1·8 k.cal. and after X-ray irradiation for 1000 min., – 5·0 k.cal. This latter figure is shown independently to be very close to the equilibrium value of – 5·1 k.cal. F. I. G. R.

2988. Structure of Radium Fluoride. G. E. R. Schulze. *Zeits. f. phys. Chem.* 32. *Abt.*B. 6. *pp.* 430–432, 1936.—RaF_2 is cubic, *a* 6·368 Å, *d* 6·75, 4 molecules in the unit cell. The structure is the same as that of CaF_2, implying a coordination number 6 for Ra^{++}, and an ionic radius 1·52 Å. C. A. S.

2989. Rotation of Borofluoride Group in Crystal Lattice. C. Finbak and O. Hassel. *Zeits. f. phys. Chem.* 32. *Abt.B.* 6. *pp.* 433–438, 1936.—The cubic high temperature modifications of the borofluorides of NH_4, K and Na are examined by powder and rotation photographs. It is concluded that the rotation of the BF_4 ion in these substances is analogous to that in the corresponding perchlorates [see Abstract 1948 (1936)]. The change from the orthorhombic to the cubic modification is followed in the case of a single crystal. J. T.

2990. Three-Dimensional Patterson Method and Structures of Proustite, Ag_3AsS_3, and Pyragyrite, Ag_3SbS_3. D. Harker. *J. Chem. Phys.* 4. *pp.* 381–390, *June,* 1936.—Patterson's method can be simplified for the particular case of these crystals; owing to their symmetry properties. The structures consist of two interpenetrating frameworks, apparently without any chemical bonds. One framework contains only right-handed spirals, and the other only left-handed spirals. The space-group is $C_{3v}^6 - R3c$. F. I. G. R.

2991. Application of the Theory of Thermal Fluctuation to the Region of the Mesophase (Liquid Crystals). H. Zocher. *Kolloid Zeits.* 75. *pp.* 161–163, *May,* 1936.—The applications of the Bose swarm theory by Ornstein [see Abstract 59 (1935)] are restricted to a definite group of phenomena at thick layers of nematic substances, whereas for thin nematic layers and smectic systems in general such experimental explanations cannot be given. It is now shown that even for the thicker nematic layers the Bose conception is invalid, and must be replaced by the continuity or strain theory. The following phenomena are shown to be capable of treatment by the theory of thermal fluctuations : The Mauguin scintillation ; the uniform turbidity of orientated regions and their degree of polarisation as well as their temperature and field dependence. The thermal movements are decisive for the temperature dependence of the different kinds of anisotropy. H. H. Ho.

2992. X-Ray Structure of Phrenosinic (Cerebronic) Acid and its Oxidation Products. (Miss) D. M. Crowfoot. *Chem. Soc., J. pp.* 716–718, *May*, 1936.—The following determinations have been made :

Substance	*a*	*b*	*c*	B	Mols. in unit cell	Space group	$^{d}001$
1. Phrenosinic acid	6·1				4	P1	53·9
2. Oxidation product of 1, B	5·57	7·41			4	$P2_1/a$	56·5
Do., C	9·0	5·0	65·8	128°	4	$P2_1/a$	51·8
3. n-$C_{23}H_{46}O_2$	5·5	8·8		73° (γ)	4	$P1_1$ or P_1	53·1
4. n-$C_{24}H_{48}O_2$	9·0	4·97	66·5	127·5°	4	$P2_1/a$	52·8
5. K salt of 2							52·6
6. $KC_{23}H_{45}O_2$							51·7
7. $KC_{24}H_{47}O_2$	5·6	4·2	65·4	124°	2	$P1_1$ or $P1^+$	54·2

The significance of the above is discussed leading to the conclusion that 2 is not pure 3, but, while consisting mainly thereof, contains also some $C_{25}H_{50}O_2$ and possibly even higher acids. C. A. S.

2993. Molecular Interactions and Structure of Liquids. P. Girard and P. Abadie. *J. de Physique et le Radium*, 7. *pp.* 211–214, *May*, 1936.—A more detailed account of work previously summarised [see Abstract 1436 (1936)]. C. A. S.

2994. Volume of an Anisotropic Liquid in Magnetic Fields. D. Beneszewicz. *Acta Physicochimica*, 4. 4. *pp.* 607–612, 1936. *In German.*—From 3000 to 17,000 gauss, the volume (v) is constant, with an accuracy of $dv/v = 3 \times 10^{-7}$. F. I. G. R.

2995. Orientation of Potassium Fluoborate on Mica and Barytes, and of Sodium Sulphite by Mica. L. Royer. *Comptes Rendus*, 202. *pp.* 1687–1689, *May* 18, 1936.—If KBF_4 crystallises on a fresh flake of mica it is orientated thereon in the same way as $KMnO_4$, $KClO_4$, and NH_4ClO_4. $BaCrO_4$ probably behaves in the same way. On barytes KBF_4 is orientated so that faces of the same notation coincide. Anhydrous Na_2SO_3 has one dimension of its unit cell (5·44 Å) nearly the same as one of that of mica (5·12 Å), and accordingly is also orientated when crystallising on a flake thereof. C. A. S.

2996. Elastic Constants, Resistivity, and Thermal Expansion of Single Magnesium Crystals. E. Goens and E. Schmid. *Phys. Zeits.* 37. *pp.* 385–391, *June* 1, 1936. *From the Reichsanstalt.*—By analysis of measurements on single crystal rods of different orientation, the following results are obtained for 99·95 % Mg (in units of 10^{-13} $cm^2./dynes$) $S_{11} = 22 \cdot 15$, $S_{12} = -7 \cdot 7$, $S_{44} = 60 \cdot 3$, $S_{13} = -4 \cdot 93$, $S_{33} = 19 \cdot 75$. Addition of Zn up to 2·3 %, which affects lattice dimensions only slightly, has no detectable effect on S_{33}. Resistivity values are $\rho \parallel = 3 \cdot 775$ $\rho_\perp = 4 \cdot 530$ (both in units of $10^{-6}\,\Omega$ cm.$^{-1}$ at 18° C., compared with Bridgman's values of 3·89 and 4·60 for Mg of comparable purity at 22·5° C. The plot of $\sin^2\phi$ against ρ_φ is a straight line within 0·5 %, in conformity with the theoretical expression $\rho_\varphi = \rho\parallel - (\rho\parallel - \rho_\perp)\sin^2\phi$. The effect of temperature on resistivity and results of thermal expansion investigations are tabulated. The anisotropy of Mg crystals in physical properties is markedly less than for Zn or Cd, but greater than might be anticipated from the close resemblance between the squat hexagonal Mg cell ($c/a = 1 \cdot 625$) and the dense face-centred cube. D. R. H.

***2997. Apparatus for Taking Equi-inclinational Weissenberg Photographs. M. J. Buerger.** *Zeits. f. Krist.* 94. *pp.* 87–99, *June*, 1936. *In English.*—The apparatus, specially suitable to the equi-inclination beam, ($B = \mu$) technique with addition of several minor conveniences, is described in detail and figured, with directions for adjustment, etc. [See Abstract 4088 (1935).] C. A. S.

See also Abstracts **2954, 3043, 3187, 3191, 3351.**

DENSITY.

See Abstract **3046.**

DIFFUSION AND OSMOSIS.

2998. Theory of Diffusion. T. Katsurai and K. Kawashimo. *Kolloid Zeits.* 75. *pp.* 37–39, *April*, 1936.—The differential equation for diffusion and its solution are discussed for the case where colloid particles move with constant velocity under the influence of an external force. J. K.

2999. Diffusion of Gas Emerging from Capillary Tubes. G. Costeanu and P. Renaud. *Comptes Rendus*, 202. *pp.* 1511–1514, *May* 4, 1936.—In an endeavour to obtain information regarding the velocity distribution across a jet of molecular rays issuing from a capillary of diameter of the same order as the mean free path of the molecules, a current of water vapour issuing from a capillary and impinging on a flat polished Na surface was found to produce no result, but the introduction of air caused the formation of a ring pattern. Other similar phenomena are mentioned. They are ascribed to the interference of the incident and reflected streams and, in some instances, deformation of the flat surface may play a part. It is suggested that the rings could be used to investigate the validity of the application of de Broglie's formula $\lambda = h/mu$ when neighbouring media have small relative velocities. P. H. B.

3000. Permeability of Palladium to Hydrogen. V. Lombard, C. Eichner and M. Albert. *Comptes Rendus*, 202. *pp.* 1777–1779, *May* 25, 1936.—Pd suffers an increasing and irreversible loss of permeability to H_2 when heated therein above 500°–550°, the more rapidly the higher the temperature. Further loss can be stopped at any time by lowering the temperature below 450°–500°, and the power can be recovered by heating in a current of air at 500°, cooling in air, and then heating in H_2 at ≯ 140° (if this is done at 500° there is no increase in permeability, but rather the reverse). This series of changes may be repeated indefinitely and appears to be connected with changes in the state of the surface of the Pd. C. A. S.

See also Abstracts **2942**, **3059**.

ELASTICITY AND PLASTICITY.

3001. Force at a Point in the Interior of a Semi-Infinite Solid. R. D. Mindlin. *Physics*, 7. *pp.* 195–202, *May*, 1936.—A solution of the three-dimensional elasticity equations for a homogeneous isotropic solid is given for the case of a concentrated force acting in the interior of a semi-infinite solid. This represents the fundamental solution having a singular point in a solid bounded by a plane. From it may be derived, by a known method of synthesis, the solutions for the semi-infinite solid which correspond to the solutions known as nuclei of strain in the solid of indefinite extent. AUTHOR.

3002. Coefficients of Elasticity of an Anisotropic Solid. L. Lecornu. *Comptes Rendus*, 202. *pp.* 1541–1544, *May* 11, 1936.—The significance of the 21 coefficients of elasticity of an anisotropic solid is discussed in terms of the two indicatrices relating to dilation and stress. **Errata**, *ibid. p.* 1724, *May* 18, 1936. J. S. G. T.

3003. Deformation of Elastic Arcs. E. Volterra. *Comptes Rendus*, 202. *pp.* 1560–1563, *May* 11, 1936.—A simplified treatment of elastic systems is given by assuming the existence of virtual internal binding forces which only slightly modify the deformations. The case of a stretched solid with rectilinear or curved axis is worked out. N. M. B.

3004. Problem of Barré de Saint-Venant for a Homogeneous Non-Isotropic Imperfectly Flexible Body. C. Platrier. *Comptes Rendus*, 202. *pp.* 1650–1653, *May* 18, 1936.—B. de Saint-Venant treated the problem of the elastic equilibrium of a long homogeneous prism. A more general treatment of the problem is here given. An alternative generalisation is given in a note by **E. Jouguet.** J. S. G. T.

3005. Random Fracture of a Brittle Solid. C. C. Lienau. *Frank. Inst., J.* 221. *pp.* 485–494, *April*; 673–686, *May, and pp.* 769–787, *June*, 1936.—A brittle solid is defined as one having a tenacity small in comparison with its rigidity. The task of specifying and predicting the probable size and shape of a fragment obtained from a crushing or grinding mill is attempted. The problem is concerned with the relations between fragment statistics, properties of the material and a set of random mechanical boundary conditions. Despite complications, three general principles are found to be applicable. Ordinary conservation principles are not disputed except in regard to the mode of their application. The manner in which chance enters the phenomena may be stated as a variant of the entropy principle, *viz.*, that the surface of a brittle material is either increasing or is stationary. This principle permits the calculation of the size and shape probabilities of the fragment by assuming ordinary elastic solid theory valid up to the point of fracture. Distinction between perfect and statistical homogeneity must be preserved in order to discuss the problem of very small fragments. Surface friction and plastic deformations are assumed to be negligible. The 1-dimensional form of the Poisson " law of small numbers " gives the required distribution functions whilst the equation of the new surface and the Poisson law yield the size-shape probabilities for the case of the 3-dimensional statistically homogeneous isotropic brittle solid. The resulting formulæ are in agreement with experimental results. Fracture statistics for 1200 thin rods are analysed and a mechanical model of the Poisson series is described. H. J. H. S.

3006. Change of Penetration with Temperature of Various Asphalts. I. Bencowitz and E. S. Boe. *Indust. and Engin. Chem.* (*Analytical Edition*) 8. *pp.* 157–162, *May* 15, 1936.—In this investigation a simple equation, $p = A + B \times C^t$, is found to express the variation of the penetration of thirteen asphalts with temperature. Several sources and methods of processing are represented in the asphalts studied. The equation can be solved when three penetrations obtained with the same weight and for the same period of time at different temperatures are known. By means of this equation a simple index, $p_2 - p_1$, is found to represent adequately the order and the relative magnitude of the temperature susceptibility of the thirteen asphalts. AUTHORS.

3007. Bituminous Plastics. R. N. Traxler. *Indust. and Engin. Chem.* (*Analytical Edition*) 8. *pp.* 185–188, *May* 15, 1936.—In this paper, a bituminous plastic is considered as any asphaltic material which shows a definite deviation from viscous flow, *i.e.*, exhibits a curvilinear relationship between flow and shearing stress. Methods for studying flow properties are first discussed, following which come descriptions with data of applications to the plasticity of filled bitumens, paving mixtures, roofing asphalts and flooring materials. All these substances exhibited, in varying degrees, elasticity, thixotropy, and comparatively great resistance to deformation; the more highly filled materials frequently showed the phenomenon of dilatancy. H. H. Ho.

***3008. "Microid" Polarised-Light Apparatus.** *Engineering*, 141. *pp.* 584–586, *May* 29, 1936.—Describes a new and relatively inexpensive apparatus produced to facilitate individual laboratory work in the applications of polarised light. A pile of glass plates is used as polariser and analyser, and calibrated sheets of cellophane are used for making exceptionally large quarter-wave plates required for producing circularly-polarised light for photoelasticity experiments. The model described is that used for projection purposes, the various components being mounted on conical or tripod stands or mounted on a T-section bar bolted to the projection lantern which is fixed to an adjustable stand on castors. The use of the apparatus for photelastic stress measurements, using celluloid, is then described, thereby indicating one of the many instructive experiments which can be carried out with the apparatus. R. C. F.

***3009. Measurement of Small Pressure Differences at High Pressures. E. Schmidt.** *V.D.I.* 80. *pp.* 635–636, *May* 23, 1936.—The ring balance frequently used for the measurement of small pressure differences at high pressure is described. A more sensitive apparatus of the horizontal beam balance type, which has been developed to measure pressure differences with high accuracy up to absolute pressures of 1000 atmospheres, is also described and illustrated. At this pressure a difference of 1/20 mm. Hg can be detected, and the apparatus has been used in connection with the determination of viscosities at high pressures. R. W. P.

***3010. Illumination of Mercury Menisci. S. C. Collins and B. E. Blaisdell.** *Rev. Sci. Instruments*, 7. *pp.* 213–214, *May*, 1936.—If pressures are to be measured accurately by means of a mercury manometer and cathetometer, the problem of illumination of the menisci is important, the apparent position of a mercury surface being determined partly by the character of the light falling on it. A common method is to allow diffuse light to pass through a narrow slit on to the meniscus. The authors study the effect of slit-width, and the use of spherical and cylindrical lens systems on the apparent position of the meniscus. It is concluded that illumination from a cylindrical lens is to be preferred to either that from a spherical lens or to diffuse light. C. J. B. C.

See also Abstracts 3015, 3275, 3342.

GRAVITATION.

3011. Gravity Measurements in Great Britain. E. C. Bullard and H. P. L. Jolly. *Roy. Astron. Soc., M.N., Geophys. Supplement*, 3. *pp.* 443–477, *April*, 1936.—A history of gravity observations, with full tables, is given from Kater's in 1817 down to the present day. Gravity anomalies are calculated on Hayford's hypothesis for various depths of compensation. The anomalies increase westwards, and are partly accounted for by the difference in density between the younger rocks to the S.E. and the older to the N. and W. To account fully for the anomalies it is necessary to assume that the palæozoic rocks of the Hebrides are denser than those under the east of England. W. A. R.

HYDRODYNAMICS AND AERODYNAMICS.

3012. Vortices. A. Masotti. *Accad. Lincei, Atti*, 23. *pp.* 133–138, *Jan.* 19, 1936.—The paper is a preliminary note of the plane motion set up in a fluid sheet of indefinite extent by two vortex-sources, liberated with constant intensity. W. A. R.

3013. Propagation of Waves on Water. J. Baurand. *J. de Physique et le Radium*, 7. *pp.* 215–222, *May*, 1936.—A multivibrator is used to make a cylinder vibrate and dip into water to cause waves to spread out over the surface. Details of the state of the liquid and cylinder surfaces, the amplitudes of the cylinder and liquid waves are considered. The optical method of studying the waves is given in a previous paper [see Abstract 4738 (1932)]. Results agree with Kelvin's formula for phase velocity and the velocities of the front and rear of the wave train are approximately the Rayleigh-Gouy group velocities (although they may be greatly dispersed.) The experimental waves are sinusoidal, but the greater or less damping caused by viscosity accounts for the deviation from Kelvin's formula. H. M. B.

3014. Design of Falls with Reference to Uplift Pressure. G. Ram and V. I. Vaidhianathan. *Indian Acad. Sci., Proc.* 3A. *pp.* 360–368, *April*, 1936.—The uplift pressures under hydraulic works on porous foundations, such as are built at the falls in canals and rivers, are determined. Two series of experiments are carried out and the pressure distributions are obtained for ordinary combinations of sheet pile and floor. A method of obtaining the pressure distribution approximately by the application of theory is also indicated. [See Abstract 1122 (1936).] AUTHORS.

3015. Structural Mechanics of Viscous Elastic Continua. Part I. H. Umstätter. *Kolloid Zeits.* 75. *pp.* 135–142, *May*, 1936.—This paper is a contribution to the hydrodynamical theory of anomalous turbulence [see Abstract 4857 (1934)]. It is shown that tangential disturbances in Maxwell systems with finite velocity in the form of a compressionless shear wave are propagated perpendicular to the plane of the tangential movement. The cause of this vicinal effect lies in the occurrence of a relaxation period which is determined by a characteristic structural constant, and this period also determines the elastic, plastic and thixotropic behaviour of the viscous elastic system. The action proceeds by the circumstance that every viscous elastic change at constant velocity produces a quasi-stationary state of stress. During the latter state, differences of intra-laminar stress occur between layers which give rise to an oblique deformation when the strengths of the lamellæ are exceeded. The turbulence condition is given, therefore, by the relationship between the tensile strength of the lamellæ and the difference between the intra-laminar stresses. The essential cause of turbulence is therefore to be found in the structural viscous behaviour of Maxwell systems. H. H. Ho.

3016. Flow of Structurally Viscous Materials. W. Philippoff. *Kolloid Zeits.* 75. *pp.* 142–154, *May*, 1936.—This paper is the second publication by the author on the theory of structural viscosity [see Abstract 2427 (1935)], wherein it is shown that the conception of laminar stationary flow can be defined as a definite form of flow independent of the constant viscosity with respect to the parabolic velocity profile. In this generalised sense, non-Newtonian liquids can flow laminarly according to certain frictional laws. Based on the previous assumption, the velocity profiles have been calculated for the capillary and Couette-apparatus according to different laws of friction. The representation of the flow curve in PV-coordinates has been discussed anew, in order to show how the frictional law is related to the flow curve. From theoretical considerations, those possibilities have been worked out which can effect a decision as to the existence of the general-laminar stationary flow for substances with $\eta =$ const. in the form now developed. Experimental evidence is assembled in support of the above points. [See following Abstract.] H. H. Ho.

3017. Measurement of Flow of Structurally Viscous Liquids. W. Philippoff. *Kolloids Zeits.* 75. *pp.* 155–161, *May*, 1936.—A quantitative comparison of the Couette-apparatus with the capillary viscometer is described, from which it follows that the general laminar flow [see preceding Abstract] is present with all its consequences including those from the most anomalous liquids. It is therefore immaterial which apparatus should be chosen in order to investigate the relationships between structurally viscous substances. Various corrections are described and discussed. H. H. Ho.

3018. Variable Period of Flow of a Liquid in an Infinite Capillary Tube. A. Grumbach. *Comptes Rendus*, 202. *pp.* 1653–1654, *May* 18, 1936.—Equations are given for the flow of liquid in a cylindrical tube any time after the liquid has begun to flow. It is found that the constant rate of flow is rapidly established and the quantity of liquid which passes a point after 100 sec. is calculated. H. M. B.

3019. Fluid Motion at Velocities Approximating to that of Sound. D. Riabouchinsky. *Comptes Rendus*, 202. *pp.* 1389–1391, *April* 27, 1936.—The method of analysis of fluid motion previously applied to a compressible fluid having local velocities exceeding that of sound [see Abstract 1998 (1936)] is now extended to include the cases where this velocity is either definitely below this value, or is fluctuating above and below it. The necessary modifications to the principal equations are given and conclusions are drawn as to the nature of the fluid motion. R. W. P.

3020. Rate of Fall of Large Particles. N. Fuchs. *Techn. Phys., U.S.S.R.* 3. 3. *pp.* 254–257, 1936. *In German.*—It is pointed out that using the relation between C ($= 2K/\pi\rho r^2u^2$) and R ($= 2\rho ru/\eta$) apparent from the researches of the last 20 years—see *Handbuch der Experimentalphysik Bd.* IV. 2. *p.* 348—in a short calculation based on the equality of the forces of gravity and hydrodynamic resistance K acting on a falling particle of density γ, curves connecting r and u be drawn for given values of ρ, γ and η. As an example such curves are given for a particle of density $\gamma = 12$ falling in air. This example shows that Stokes' law does not hold when the particle radius r exceeds 10 μ. P. H. B.

KINETIC THEORY OF MATTER.

3021. Radius of Action of Strongly Vibrating Molecules by Molecular Beam Method. N. Sasaki and E. Nishibori. *Imp. Acad. Tokyo, Proc.* 12. *pp.* 10–12, *Jan.*, 1936. *In German.*—An I_2 molecular beam is subjected to the simultaneous action of an intense Hg atomic beam and an intense beam of light. Light from both continuous and line spectra is absorbed; the former producing dissociation of the molecules into atoms and the latter excites molecular electronic states with consequent immediate transition of the molecules into normal electron states with more or less excited vibration levels. The density of the "excited" molecules decreases along the beam on account of photodissociation and collisions with Hg atoms. The relative density decreases caused by Hg atoms or light alone, and by both acting together are measured with a sensitive rotation balance. From the measurements the ratio of the effective cross-sections of the excited and ordinary molecules with respect to Hg atoms is calculated to be 2·56. This large value cannot be explained in terms of band spectra theory and is probably attributable to the chemical reaction between I_2 molecules and Hg atoms. J. E. K.

3022. Brownian Motion of a Linear Lattice. I. Bessonov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences,* 1. 8. *pp.* 323–327, 1936.—Krutkow has previously [see Abstract 2841 (1935)] developed a method for the solution of linear problems concerning the theory of the Brownian motion, and has carried out the computations for the case of the vibrator. The author now applies this method to the problem of the Brownian motion of a linear lattice, which is considered as a mechanical system arising out of n points of equal mass, which are arranged at equal distances upon an elastic thread which itself has no mass. The paper is entirely mathematical. H. H. Ho.

See also Abstracts 2999, 3056, 3059, 3295.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***3023. Cadmium Red Line as Standard of Wave-Length. C. V. Jackson.** *Roy. Soc., Proc.* 155*A*. *pp.* 407–419, *June* 2, 1936.—An investigation of the conditions necessary to ensure accurate reproducibility of the wave-length of the Cd. red line from various sources is described. The sources used were Michelson lamps of the original vacuum type, and as modified by Pérard containing air at a pressure of about 1 mm., Osram hot-kathode discharge lamps and a Schüler hollow-kathode lamp. Under certain specified conditions all sources give a wave-length identical and reproducible with an accuracy of about ± 0·0001 Å. The Michelson lamp as modified by Pérard is found to be superior to the original vacuum type, and in the Osram lamp the exciting current needs to be limited to a value of 1·1 A, to ensure reproducibility with other sources. H. B.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

3024. Potential and Wave Functions in *n* Dimensions. B. van der Pol. *Physica*, 3. *pp.* 385–392, *June*, 1936. *In English.*—A solution of the wave equation in *n*-dimensional space may be derived from a solution in space of $n + 1$ dimensions (method of descent, Hadamard). The author gives several new applications of this method, containing discontinuities, obtained by means of the symbolical calculus. He then shows that such a solution may equally well be obtained from one in a space of n–1 dimensions (ascending method). The classical expressions for the potential and for waves, as given by Whittaker for the case of space in three dimensions, are thus obtained by the author in a simple manner and in a slightly more generalised form. The examples given involve the functions of Bessel and of Hankel, and also spherical functions of two types. The paper is entirely mathematical. H. H. Ho.

3025. Generalisation of Maxwell's Definition of Solid Harmonics to Waves in *n* Dimensions. B. van der Pol. *Physica*, 3. *pp.* 393–397, *June*, 1936. *In English.*—In this mathematical paper, the author shows how an expression of a potential in spherical harmonics, and given by Maxwell for the case of 3-dimensional space, may be generalised for a space of *n* dimensions and for the wave equation by means of a formula of analogous type, using also the Bessel and Gegenbauer functions. It is shown that in all the expressions where a Bessel- or Hankel-function occurs, it may be replaced in both members by any solution of Bessel's equation of the same order. H. H. Ho.

3026. Operational Representations of Confluent Hypergeometric Functions and their Integrals. S. C. Dhar. *Phil. Mag.* 21. *pp.* 1082–1096, *June*, 1936.—Recently, van der Pol [see Abstract 2005 (1930)] has given a process by which linear differential equations with variable coefficients can be solved by the Heaviside operational method, and the author now applies it to obtain operational representation of confluent hypergeometric functions. Several relations and integrals are subsequently derived. H. H. Ho.

3027. Generalisation of Lorentz Transformation. K. V. Sastry. *Phil. Mag.* 21. *pp.* 1111–1112, *June*, 1936.—Tavani's deduction of a generalisation of the Lorentz transformation for curvilinear motion is considered unsatisfactory [see Abstract 3147 (1934)], and an alternative deduction is given. J. S. G. T.

***3028. Calculating Machine, Employing Binary Numeration. R. Valtat and M. d'Ocagne.** *Comptes Rendus*, 202. *pp.* 1745–1748, *May* 25, 1936.—A calculating machine employing the binary scale of numeration and embodying devices for converting numbers in the decimal scale to the binary scale and conversely is briefly described. J. S. G. T.

***3029. Mechanism for Solving Systems of Linear Equations. P. C. Vidal.** *Comptes Rendus*, 202. *pp.* 1748–1751, *May* 25, 1936.—The principles employed in a machine for solving systems of linear equations are briefly explained. Essentially all such equations are reduced to equations with unit coefficients. J. S. G. T.

See also **Abstracts 2955, 3038, 3107, 3108.**

MECHANICS, CLASSICAL.

***3030. Relation between Rate and Arc for a Free Pendulum. E. C. Atkinson.** *Phys. Soc., Proc.* 48. *pp.* 606-617, *July* 1, 1936.—When a pendulum swings about a centre in a vacuum the well-known circular deviation gives the increase of period with amplitude. For the case in which the pendulum is suspended by a spring the period has been calculated but not the change with amplitude. The presence of air increases the period in three ways : for two of these the amount has not been computed and may depend on amplitude. Thus for the ordinary clock pendulum, apart from the effect of the impulse, experiment is necessary to compare the real amplitude deviation with the computed circular deviation. In about 1856 J. M. Bloxam recorded a change of rate between two amplitudes of only one-half the circular difference. The writer, on the other hand, has found five rates which fit the circular deviation within less than 1 %. AUTHOR.

***3031. Airy's Disturbance Integrals and Knife-Edge Supports for Pendulums. E. C. Atkinson.** *Phys. Soc., Proc.* 48, *pp.* 618-625, *July* 1, 1936. A century ago Airy employed two integrals to find the effect of a small disturbance on harmonic motion. More general use of these would have saved much effort in theoretical investigations. In the present paper the process is used to find the effect of a material knife-edge, consisting of a cylinder of any form rolling on another supporting cylinder, on the period and isochronism of a pendulum. AUTHOR.

***3032. Mechanical Magnification of Small Movements. Z. Bay.** *Zeits. f. Physik,* 100. 3-4. *pp.* 253-262, 1936.—A specially constructed arrangement of four co-planar links, designed for the magnification of small movements, is described and the appropriate kinetic theory, together with an approximate dynamic theory of the arrangement is given. It is shown that with suitable choice of dimensions the apparatus gives a considerable magnification and introduces little distortion. Application of the device to the construction of a l.f. oscillograph is described and tested experimentally. A. W.

See also Abstracts 3024, 3025.

MECHANICS, QUANTUM.

3033. Reality of Quantum Mechanics. R. Dugas. *Comptes Rendus,* 202. *pp.* 1414-1416, *April* 27, 1936.—The Einstein-Podolsky criterion of " reality " is criticised and it is pointed out that, in general, no " observable " can satisfy this criterion. The Einstein paradox depends on assigning " reality " to a system on which no direct measurement is performed. G. C. McV.

3034. Scattering of Dirac Waves. J. Winter. *Comptes Rendus,* 202. *pp.* 1416-1418, *April* 27, 1936.—The mathematical solution, already given, of the problem of the scattering of a plane electron wave by a spherical potential region, is completed. [See Abstract 2561 (1936).] G. C. McV.

3035. Properties of the Acceleration Operator and a Remark Concerning the Potential. A. Datzeff. *Comptes Rendus,* 202. *pp.* 1486-1488, *May* 4, 1936.—A wave-mechanical theory of the motion of a system of massive particles is briefly discussed. Results analogous to Koenig's theorems in classical mechanics are deduced, and it is shown that the potential of the system is approximately equal to that of the centre of gravity of the system. J. S. G. T.

3036. Fundamental Equations of Elementary Particles. A. Proca. *Comptes Rendus,* 202. *pp.* 1490–1492, *May* 4, 1936.—A wave-mechanical theory of the motion of charged particles in an external field is briefly developed, expressions being derived for the Lagrangian function, current density, the tensor-density of the motion, and the density of the electric and magnetic moment. J. S. G. T.

3037. Semi-Vectors and Tensors. B. Kwal. *J. de Physique et le Radium,* 7. *pp.* 223–226, *May,* 1936.—The relations between the semi-vectors of Einstein and Mayer, the spinors of v. de Waerden and the author's " binors " are worked out. The latter are real magnitudes with eight components. The relations between these three types of semi-vectors and ordinary field-tensors are also given. G. C. McV.

***3038. Self-Consistent Field for Tungsten. M. F. Manning and J. Millman.** *Phys. Rev.* 49. *pp.* 848–853, *June* 1, 1936.—Calculations of the self-consistent field of W are carried out with the aid of the differential analyser. A discussion of the machine set-up and an outline of a method for estimating initial fields are given. AUTHORS.

3039. Rotation-Vibration Wave Equation for a Polyatomic Molecule. M. Eliašević. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences,* 1. 7. *pp.* 295–298, 1936. *In English.*—It is required to set up a rotation-vibration wave equation for a polyatomic molecule in a form which is suitable for applications. The problem is divided into two parts. Firstly, the rotation coordinates and the normal coordinates of vibration are defined ; these correspond to those previously selected by Eckart [see Abstract 2132 (1935)]. Secondly the wave-equation is transformed into these coordinates by applying the classical law of transformation of conjugate momenta. J. E. K.

3040. Quantum-Mechanical Treatment of Helium Hydride Molecule-Ion He-H$^+$. J. Y. Beach. *J. Chem. Phys.* 4. *pp.* 353–357, *June,* 1936.—The He-H$^+$ molecule-ion is treated by the variation method, including ionic and polarisation terms in the variation function and varying the effective nuclear charge. The equilibrium internuclear distance is found to be $1\cdot 57a_0$. Fitting a parabola to the lower part of the best potential energy curve leads to a value of $0\cdot 43$ megadyne/cm. for the force constant and a value of 2800 cm.$^{-1}$ for the fundamental vibration frequency. The minimum energy obtained for the system is $-\ 5\cdot 844\ W_H$, which, when subtracted from the best value for the energy of the He atom using the same type of variation function, gives a value for the dissociation energy of $2\cdot 02$ eV. The doubly charged ion, He-H^{++}, is found to be unstable. AUTHOR.

See also Abstracts 2930, 2953, 3024, 3025, 3203, 3265, 3349.

RELATIVITY AND ETHER.

3041. Dynamics of Special Relativity Applied to Central Forces. E. Esclangon. *Comptes Rendus,* 202. *pp.* 1469–1472, *May* 4, 1936.—The equations of motion, invariant under Lorentz transformations, of a particle moving under an inverse square law and a perturbing force inversely proportional to the distance cubed, are used to show that the advance of the perihelion of Mercury cannot be deduced from special relativity principles alone. G. C. McV.

3042. Interpretation of Page's New Relativity. H. P. Robertson. *Phys. Rev.* 49. *pp.* 755–760, *May* 15, 1936.—Page's proposed extension of the theory of relativity [see Abstract 1057 (1936)] is examined from the standpoint of the general kinematical theory developed by the present author, of which it is found to be a special case. The contention that this extension renders Einstein's theory untenable would seem to be without real foundation; for although such an attempt to treat of observers in motions other than those contemplated in the special theory of relativity must lead to a theory transcending this latter, Page's theory is shown to be readily understandable in terms of a simple, though somewhat artificial, space time of a type met in the general theory of relativity. AUTHOR.

See also Abstracts 3027, 3354.

SOLUTION.

3043. Properties of Metallic Solutions. Part I. W. K. Ssementchenko. *Acta Physicochimica,* 4. 5. *pp.* 675–704, 1936. *In English.*—The advantages of considering the generalised moment as a characteristic constant of a metal are emphasised. The mutual solubility of metals and the influence of impurities upon it, surface tension and the influence of impurities affecting the surface tension upon crystallisation are discussed from the generalised moment viewpoint. The surface phenomena described are of considerable importance in technology, as is shown. [See also Abstract 1061 (1936).] H. J. H. S.

3044. Liquid Ammonia Solutions of Metals. J. F. Chittum and H. Hunt. *J. Phys. Chem.* 40. *pp.* 581–589, *May,* 1936.—Methods for producing ammonium metal in liquid ammonia are described. Its presence in alkali metal solutions is proved. The " dissociated metal " theory of metallic ammonia solutions is critically discussed, and a colloidal metal theory is outlined to explain the properties of these solutions. The alkali solutions are evidently mixtures, and therefore the physical data are not capable of interpretation on the basis of the well-known law of physical chemistry. AUTHORS.

3045. Van der Waals Forces and the Properties of Salt Solutions. G. Kortüm. *Zeits. f. Elektrochem.* 42. *pp.* 287–292, *June,* 1936. —A comprehensive review of the subject, from which it is shown that the significance of the van der Waals forces is considerably underrated, particularly with respect to the behaviour of electrolyte solutions. A very detailed discussion follows, whereby it is shown that only from the study of these forces can light be thrown upon the unsolved problems of salt solutions. H. H. Ho.

***3046. Solubility of Carbon Dioxide in Aqueous Solutions Containing Alcohols and Sugars. H. A. Showalter and J. B. Ferguson.** *Canad. J. of Research,* 14. *Sect. B. pp.* 120–126, *April,* 1936.—A new type of solubility apparatus is described. The results of the solubility determinations of CO_2 at 15° C. are given for the following systems: alcohol-water, dextrose-water, levulose-water, sucrose-water, dextrose-alcohol-water and sucrose-alcohol-water. Certain incidental measurements of specific gravity and of vapour tension are also given. AUTHORS.

***3047. Hill Method for Solubility Determinations. T. W. Evans.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 206–208, *May* 15, 1936.—Weighed amounts of the two liquids are introduced into a suitably graduated flask which is shaken until equilibrium is reached, when the phases are allowed to separate and the volumes of the upper and lower layers read. The experiment is then repeated with a different ratio of starting materials, and the data are inserted in derived formulæ. The author investigates this method and thereby determines a suitable general choice for the volume ratios employed. A simple and inexpensive apparatus for carrying out the determinations, with the experimental results obtained, is also described. Wherever available the corresponding data obtained by other methods are given for comparison. H. H. Ho.

3048. Distribution of Picric Acid between Benzene and Mixtures of Light and Heavy Water. P. Gross and A. Wischin. *Faraday Soc., Trans.* 32. *pp.* 879–883, *June*, 1936.—The distribution of picric acid between benzene and mixtures of H_2O and D_2O at 18° C. is measured. The distribution coefficient increases with the D_2O content but not linearly. The value of the distribution constant in pure D_2O is about four times as great as in pure H_2O. This effect is due to the differences between the zero point energies in the various D- and H-linkages. The dependence of the distribution constant on the composition of the water is treated from the standpoint of thermodynamics. AUTHORS.

SURFACE TENSION AND COHESION.

***3049. Surface Tension Apparatus. L. D. Mahajan.** *Journ. Sci. Instruments*, 13. *pp.* 189–191, *June*, 1936.—An apparatus is described for the accurate and rapid determination of surface tension, density, and parachors of both mobile and viscous liquids which are available in small quantities. The results obtained with it are compared with those obtained with other types of apparatus. AUTHOR.

3050. Parachors of Methyl and Ethyl Nitrites and of Nitromethane and Nitroethane. W. A. Noyes and B. Singh. *Am. Chem. Soc., J.* 58. *pp.* 802–803, *May*, 1936.—The parachors of methyl and ethyl nitrites are determined and agree closely with those of nitromethane and nitroethane, furnishing a strong confirmation of the value of the parachor for the determination of the presence of a double covalence in a compound. A simple hypothesis is offered to account for the increase in the parachor caused by a double covalence. AUTHORS.

3051. Three-Phase Sulphur Emulsions in Autoclave Processes. K. N. Samochwalov and O. S. Koshuchowa. *Kolloid Zeits.* 75. *pp.* 217–222, *May*, 1936.—Continuing previous work [see Abstract 2573 (1936)] in an endeavour to determine the rôle of wetting in the failure of S melts in works autoclaves, it is shown that finely dispersed minerals in the presence of water and molten S act as emulsifiers. Further, the formation of three-phase emulsions proceeds in agreement with the Pickering-Schlaepfer rule; disperse minerals better wetted by S than water tend towards the formation of water emulsions in S, and those better wetted by water than S tend towards the formation of sulphur emulsions in water. Water-in-S macroemulsions are more noxious than S-in-water macroemulsions. The influence of waterglass, oakbark extract and soda, which paralyse the factors injurious to melting, depends on a reduction of the wetting angle of minerals by S and on the destruction of water-in-S macroemulsions. P. H. B.

3052. Wetting of Powders of Varying Fineness. Z. W. Wolkowa. *Acta Physicochimica*, 4. 4. *pp.* 635–646, 1936. *In German*—The wetting is measured by the impregnation method [see Abstract 3096 (1934)]. The ratio r/r_0 between the mean impregnation of water and that of non-polar liquids in quartz and calcite powders remains constant over a wide range of degrees of powder fineness. A decrease in r/r_0 for very fine powders of these substances can be explained by the formation of an oriented water layer of thickness nearly $0 \cdot 01\,\mu$ at the surface of the particles. A similar decrease in r/r_0 for very fine fluorite and corundum powders can only be explained by a change in the wetting hysteresis with increase in fineness. Some powders are rendered hydrophobic by adsorbed oleic acid and this process is complete when a small part of the powder surface is covered by the adsorbed layer. P. H. B.

3053. Mechanism of the Rise of Hydrosols and Coloured Solutions through Porous Bodies. A. Boutaric and Paulette Berthier. *Comptes Rendus*, 202. *pp.* 1781–1783, *May* 25, 1936.—Theory indicates that the colouring matter in a solution is retarded by adsorption on the porous body (*e.g.*, filter paper). The progressive increase of force which pulls up the solvent may be colloidal and also the evaporation of the solvent, even in a saturated atmosphere, may cause a continual rise of the solvent. These two causes may account for the upward movement of the colouring matter after the solvent has reached its maximum height. The theory is expressed mathematically in terms of distance and time and supported by experimental results on methyl blue. H. M. B.

See also Abstracts 2923, 2930, 2965, 3043, 3251, 3252.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

3054. Nutation, Longitude and Wireless Time Signals. R. v. d. R. Woolley. *Observatory*, 59. *pp.* 164–168, *May*, 1936.—Nutation enters into time determination as the difference between true and mean sidereal time; short and long period nutations and their change of rate are defined. Clock corrections sometimes refer to an equinox from which only short period nutation has been removed (Greenwich to 1934, Paris mean daily clock rates, 'Sternzeit' of Berlin *Jahrbuch*), sometimes to mean sidereal time corrected for all nutation terms (Greenwich from 1935, Nautical Almanac nutation columns). Examples of the reduction in both cases are given. T. L. M.

***3055. Suspended Chronometer. R. A. Sampson.** *Roy. Soc. Edinburgh, Proc.* 56. 1. *pp.* 13–25, 1935–1936.—Two experiments made with chronometers suspended by bifilar suspensions are described and the results discussed. Certain anomalous effects on the rate of the chronometers are noted when the natural period of the bifilar suspension is synchronous with the impulse period of the chronometer. A mathematical investigation is also given and the bearing of the results on chronometer practice is mentioned. J. S. C.

VACUA, HIGH.

See Abstract 3010.

VISCOSITY, FRICTION AND LUBRICATION.

3056. Viscosity of Suspensions. Part V. E. Guth. *Kolloid Zeits.* 75. *pp.* 15–20, *April*, 1936.—The present paper gives a critical review, including the literature up to date, of the theory underlying the influence of Brownian movement on the viscosity of suspensions. [See Abstract 2052 (1936) and following Abstract.] J. K.

3057. Viscosity of Suspensions. Part VI. F. Eirich, H. Margaretha and M. Bunzl. *Kolloid Zeits.* 75. *pp.* 20–37, *April*, 1936.—Increase in viscosity can vary within wide limits when brought about by suspended, lengthy, solid ellipsoids without Brownian movement. A definite value can only be obtained for definite streaming conditions, Therefore according to the viscometer η appears to depend on the conditions of flow. In so far as a capillary viscometer is concerned an increase in velocity appears to give a decrease in the relative viscosity, probably due to parallel orientation of the little rods, until a minimum value is obtained. [See preceding Abstract.] J. K.

3058. Viscosity of Liquids. D. B. Macleod. *Faraday Soc., Trans.* 32. *pp.* 872–876, *June,* 1936.—If π is the internal pressure of a liquid, $\pi = \mathrm{RT}/v\text{-}b$ from van der Waals' equation. It is suggested that the expression $\pi = \pi_0 e^{c'/\mathrm{T}v}$ shows the change of π with volume and temperature. Combining the two equations, the value of $(v\text{-}b)$ can be calculated; this is found to agree reasonably with the observed values for octane. Since there is a certain degree of association in all liquids that changes with temperature, this will change the effective molecular weight and an equation of the type of Andrade's for viscosity is deduced. The error is very small for values obtained from this equation for octane compared with those by experiment. H. M. B.

3059. Viscosity and Diffusion Coefficients of Atomic Hydrogen and Atomic Deuterium. I. Amdur. *J. Chem. Phys.* 4. *pp.* 339–343, *June,* 1936.—The viscosity of H is recalculated from Harteck's experimental values for the relative viscosity of H-H_2 mixtures, on the assumption that H like H_2 may be regarded as a van der Waals gas. The numerical results confirm this assumption and permit the evaluation of diffusion coefficients for H-H_2, D-D_2, H-D_2, D-H_2 and D-H binary mixtures as well as the viscosity of D. AUTHOR.

3060. High-Temperature Viscosities of Liquid Petroleum Fractions. K. M. Watson, J. L. Wien and G. B. Murphy. *Indust. and Engin. Chem.* 28. *pp.* 605–609, *May,* 1936.—The capillary tube method is used to determine the kinematic viscosity between 100° and 800° F. of a series of liquid hydrocarbons ranging from pure benzene and *n*-heptane to lubricating oils and products from commercial cracking units. The data can be satisfactorily expressed by the equation, $\log(\log \mu/s + 1{\cdot}7) = a(t + 100) + b$, for temperatures above 210° F. On the basis of this equation a high-temperature viscosity chart is developed. A nomograph is developed permitting the estimation of the viscosity-temperature curve of a liquid from laboratory inspection data. Pressures up to 500 lbs./in^2. have little effect on the kinematic viscosity in the range of the determinations. AUTHORS.

3061. Viscosity of Water and Water-Vapour up to the Critical Region. K. Sigwart. *Forsch. IngWes.* 7. *pp.* 125–140, *May–June,* 1936.—A modified flow method is described for the determination of the viscosity of water and water vapour at high pressures and temperatures. The results show that the viscosity of water only depends on its density, whereas that of the vapour depends on both density and temperature. For the vapour the slope of isotherms of viscosity against pressure remains practically constant up to the saturation pressure, where an increase occurs. Below 275° C. the increase in viscosity is small, amounting to only 5 % for a pressure increase of 100 atmospheres. Using experimental results obtained near and above the critical temperature and those for water, a curve of viscosity against density is drawn, from which the value of the viscosity at the critical point is found to be $3{\cdot}85 \times 10^{-6}$ kg.sec./m^2. Comparison of the results is made with data of other workers. The complete results are reproduced in a viscosity-temperature diagram in which the limiting curve and isobars are drawn. The data, including values extrapolated to 500° C., are also given in tables. R. W. P.

3062. Characteristics of Hydrocarbons. W. R. Wiggins. *Inst. Petroleum Technologists, J.* 22. *pp.* 305–327, *May,* 1936.—Viscosity and viscosity-temperature stability are physical properties of primary importance for lubricating oils. As a preliminary step, a correlation is made of available data on the influence of constitution upon viscosity and viscosity-temperature stability for the simpler hydrocarbons and an investigation is made of applying the resulting generalisations to the higher lubricating-oil hydrocarbons. Density, boiling-point, viscosity and viscosity-temperature stability are not entirely additive in a hydrocarbon but greatly depend on chemical structure. The presence of aliphatic straight-chain or branched-chain structure, of unsaturation, or of aromatic or naphthenic rings, has a specific effect upon the physical properties. J. E. B.

3063. Structure of Lubricating Greases. B. B. Farrington and W. N. Davis. *Indust. and Engin. Chem.* 28. *pp.* 414–416, *April,* 1936.—The texture of lubricating greases is correlated with the length of soap fibre by means of photomicrographs taken with dark-field illumination. The soap fibres pictured vary in length from 1 mm. to a fraction of a micron with indications that some of the fibres are of ultramicroscopic dimensions. A system of classifying lubricating greases by means of soap fibre length is proposed, and an illustration of the applicability of the microscopic method to practical grease manufacture is given. AUTHORS.

3064. Significance of Viscosity of Fats. H. R. Schulz. *Zeits. f. Physik,* 99. 9–10. *pp.* 666–668, 1936.—Several fats are examined as to viscosity, and they conform to a law of viscosity: $T = A\ \eta\ (dv/dx)^k$, where the new constant k has values from 0·10 to 0·485 at 20° C. It is concluded that lubricant fats are to be regarded as colloidal solutions. G. E. A.

3065. Coefficient of Friction for Yarns. I. J. Saxl. *Frank. Inst., J.* 221. *pp.* 789–795, *June,* 1936.—In view of the importance of the frictional characteristics in the manufacture of yarns and in the final appearance of textile products, a method has been devised with which it is possible to determine the coefficient of friction of individual yarns in absolute figures. It consists substantially in opposing the constant, rotary moment of an unbalanced wheel by the frictional resistance of a piece of yarn, loaded at each end with a definite weight. The yarn is in contact with one-half of the carefully standardised surface of the rim of the wheel. The mathematical analysis of the physical principle involved is given. The method described lends itself also to the investigation of the frictional characteristics of different weaving and knitting constructions, to the determination of the lubricating value of different throwing oil compounds and various oils, the influence of oxidation upon the lubricating value of oils, the change in the friction of yarns imparted to them by sizes and other agents. The coefficients of friction for several different types of yarn and conditioned yarn are tabulated. AUTHOR.

See also Abstracts 3016, 3017, 3018, 3020.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***3066. Aluminising of Large Telescope Mirrors. J. Strong.** *Astrophys. J.* 83. *pp.* 401–423, *June,* 1936.—A history of the evaporation process is given. This includes the contributions by Ritschl and others and describes the present technique in detail. Formulæ are developed which give the thickness of the film produced by a circular array of evaporation sources. Applications for the cases of 40-in. and the 108-in. tanks are discussed. Reference is also made to the application of non-uniform films in the figuring of mirrors. Methods of cleaning mirrors preparatory to coating are discussed. The technique of obtaining high vacuum in large tanks is treated. The reflectivities and other properties are given for evaporated films of Al and silver, as well as a Cr, Pt, Pd, Rh, Sn, Au and Cu. This includes observations on aluminised astronomical mirrors now in use for over three years. The results of a study of the oxidation (corrosion) of Al by means of measurements on transmissivity and reflectivity of partial films is reported. The different sets of equipment that have been developed in increasing size up to the 108-in. tank are described. The history of the application of the process to astronomical mirrors is given. AUTHOR.

See also Abstract 3055.

COSMOGONY.

3067. Origin of the Solar System. R. A. Lyttleton. *Roy. Astron. Soc., M.N.* 96. *pp.* 559–568, *April,* 1936.—The hypothesis of the sun having been a double star is adopted and the facility with which the companion can be removed is demonstrated. The mechanism which effects this disruption also produces the planets, giving them widely varying angular momentum per unit mass and possibly causing them all to proceed round the sun in the same general direction nearly in a plane. The later encounters between pairs of planets while in the liquid stage give promise of an explanation of satellites in the equatorial planes of the planets and may even be able to account for retrograde satellites. AUTHOR.

3068. Physical Universe. H. Dingle. *Washington Acad. Sci., J.* 26. *pp.* 183–195, *May* 15, 1936.—An account is given of the general aspects of cosmology. The historical development of the ideas of the nature of the universe is sketched and the contribution of general relativity to these ideas is indicated. Special emphasis is laid on the fact that, to an observer in a bounded space (*e.g.,* the Einstein universe), the " outside " of such a space is meaningless since it is unobservable. Spatial curvature, it is also pointed out, is merely a certain kind of relation between distance-measurements and is not a picturable property of space. The stability or instability of an Einstein universe is criticised on the ground that these terms, applied to a mechanical system, imply that there is some external agency capable of affecting the equilibrium. No outside agency can, by hypothesis, exist when the system consists of the entire universe. The universe as a whole may be static and the recession of the nebulæ may merely be a local phenomenon. The short time-scale of present cosmological theory is not regarded as a matter of great importance in view of the certainly tentative character of this theory. G. C. McV.

3069. World-Structure and the Sample Principle. G. J. Whitrow. *Zeits. f. Astrophysik*, 12. 1. *pp.* 47–55, 1936. *In English.*—It is shown that Milne's simple kinematical system may be constructed with the aid of Hubble's sample principle. The cosmological principle is then found to be satisfied *a posteriori*. Reasons are given for believing that any universe, which contains equivalent fundamental particles whose local world-pictures are identical, necessarily obeys the cosmological principle. The relations between the sample principle, the cosmological principle, equivalence, homogeneity and spherical symmetry are stated explicitly. AUTHOR.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3070. Solutions of Equations of Variations. E. W. Brown. *Roy. Astron. Soc., M.N.* 96. *pp.* 579–587, *April*, 1936.

LATITUDE AND LONGITUDE.

See Abstract **3054.**

NEBULÆ.

3071. Photographic Photometry of the Elliptical Nebulæ. R. O. Redman. *Roy. Astron. Soc., M.N.* 96. *pp.* 588–604, *April*, 1936.—Two photographic methods of determining the total apparent brightness of an elliptical nebula are discussed, especially in relation to the systematic error likely to arise from failure to record the outer regions of low surface brightness. The photographic magnitudes and intensity distributions along the principal axes of six nebulæ are given, and the results compared with those obtained elsewhere. A conventional definition of the diameter of an elliptical nebula is suggested. AUTHOR.

3072. Continuous Spectra of Planetary Nebulæ. T. L. Page. *Roy. Astron. Soc., M.N.* 96. *pp.* 604–635, *April*, 1936.—The author describes the method of observation and reduction of continuous spectrum intensities of 5 planetary nebulæ, based on their wide slit spectra, so as to ascertain their origin in emission-line nebulæ. The author finds that the Balmer continuous emission is accordant with the predictions based on the absorption coefficient law derived from quantum mechanics. The measured T_e seems to be low (near 2000° K.) and discordant with observed Balmer-line intensities; this discordance is due to self-reversal; T_e is also lower for nebulæ with stronger " nebulium " lines, because of the cooling effect of electron excitation [see Abstract 4890 (1932)]. The strong continuous emission in the visual spectrum is probably due to scattering by meteoric dust, and the effect of this on observed luminosities and temperatures of planetary nuclei is deduced; this meteoric dust has diameters of 10,000 or 20,000 Å or greater; the total mass is about equal to 10 suns if the dimensions of the dust particles are between 10^{-4} and 10^{-2} cm. A. S. D. M.

3073. Illuminated Nebulæ and Blue Sky. J. Larmor. *Observatory*, 59. *pp.* 189–191, *June*, 1936.—It has been suggested that diffuse nebulæ shine by the reflected light from bright stars in front of them. Reference is made to the two types of reflection which might be expected, firstly a scattering by particles smaller than the wave-length as proposed by Rayleigh in explanation of the blue of the sky and secondly scattering depending on interfacial reflection by dense obstacles comparable with the wave-length and the main characteristics of these types of scattering are described. It is pointed out that a situation of the exciting star in front of the nebula is not likely to be as effective as a situation inside the nebula or more especially at the side of the nebula. J. E. K.

3074. Photoelectric Magnitudes of the Brightest Extra-Galactic Nebulæ. A. E. Whitford. *Mt. Wilson Observat. Contrib. No.* 543. *Astrophys. J.* 83. *pp.* 424–432, *June*, 1936.—The integrated magnitudes of eleven of the nearest and brightest extra-galactic nebulæ are measured by means of the photoelectric photometer attached to the 10-in. Cooke photographic refractor. The advantage of the photoelectric cell in comparing stars and nebulæ is pointed out. The resulting magnitudes average brighter than either the photographic or the visual estimates previously used in computing absolute luminosities of nebulæ. AUTHOR.

See also Abstracts **3087, 3088, 3089, 3098, 3178, 3208.**

PLANETS.

3075. Analytical Representation of Lunar Relief. Georgette de Nockere. *Comptes Rendus,* 202. *pp.* 1657–1658, *May* 18, 1936.—A generalised relief map of the visible surface of the moon has been produced by H. Ritter on the basis of terminator observations ; the author applies the mathematical methods used for the earth to obtain a series representing the principal features of the map in terms of selenographic co-latitude and longitude, measured respectively from S. pole and W. limb. A chart based on the resulting formula is reproduced ; the elevation in S.W. quadrant and depression in N.E. are fairly represented. The method is applicable to certain problems of the figure of the moon. T. L. M.

STARS.

3076. Absolute Stellar Magnitudes. A. Lallemand. *Comptes Rendus,* 202. *pp.* 1569–1571, *May* 11, 1936.—The author suggests a method of determining this photographically by distributing the star's light over a small surface and by means of the photometric properties of the plate. Three successive exposures are given on it with the same duration, screens of known densities being placed upon it ; the first being of transparent plate glass ; the second a neutral wedge (absorbing about 0·75 mag.) ; and the third a deep neutral ; all three screens possessing equal optical thicknesses. The respective blackenings are measured in a microphotometer, and the author gives the method of reduction. A. S. D. M.

3077. Existence of Upper Limit to Mass of Star. J. Tuominen. *Zeits. f. Astrophysik,* 12. 1. *pp.* 72–75, 1936. *In English.*—This paper is concerned with the question whether an upper limit to the mass of a star can exist in the manner postulated by Thüring [*Astr. Nachr.* 258. 97. 1936] and by Vogt. It is shown that the existence of such a limit is very unlikely, as it would make the rate of energy generation depend on density in a way which is physically improbable. AUTHOR.

3078. Classification and Luminosity of the n and s Stars of Type A. J. A. Hynek. *Astrophys. J.* 83. *pp.* 476–486, *June*, 1936.—Data are compiled concerning the luminosity, the colour temperature, and the spectral classification of 409 of the Mount Wilson n and s stars of type A. It is shown that 255 n stars show a strong tendency to cluster closely about the spectroscopic absolute magnitude $+ 1\cdot9$. No systematic error is found in the determination of the luminosities of these stars spectroscopically and from trigonometric parallaxes. It is shown that observed differences in luminosity between the n and s stars of a given spectral class are probably due to the preferential luminosity of the n stars rather than to an absolute-magnitude effect caused by rapid axial rotation. It is shown that the differences in colour observed when the n and s stars are arranged according to Mount Wilson classes disappear when they are arranged according to Harvard spectral classes. This is strong negative observational evidence for a rotational absolute-magnitude effect. The consistency of the Harvard classification of Mount Wilson n and s stars is confirmed by a quantitative examination of the intensities of the most prominent of the usual criteria of spectral classification of A stars. The effect of rapid axial rotation upon the number of atoms active in the production of a few prominent lines of an A-type spectrum is estimated, and it is shown that the effect is so small that it would be difficult to detect it observationally, except perhaps in individual rapidly rotating giants. AUTHOR.

3079. Re-examination of 64 Orbits. W. E. Harper. *Dominion Astrophys. Obs., Victoria, Publ.* 6. 12. *pp.* 207–260, 1936.—Observations have been taken with a view to improving the periods of spectroscopic binaries. Sixty-four are here listed, the original orbits being determined by the author in all but seven cases. The period of one star was radically wrong and four others were felt to be sufficiently in error to require new solutions. The changes resulting from such solutions are, however, very small. AUTHOR.

3080. Spectroscopic Orbit of Boss 3102. W. E. Harper. *Dominion Astrophys. Obs., Victoria, Publ.* 6. 13, *pp.* 261–264, 1936.—17 single prism plates of this spectroscopic binary of type F5 discovered at Victoria in 1919 are made the basis of the determination of the orbit. The plates are measured on the micrometer engine, about 20 lines being used. The period is 32·864 days and with this value one Mount Wilson observation is in good accord. AUTHOR.

3081. Orbit of Spectroscopic Binary Boss 4217. A. McKellar. *Dominion Astrophys. Obs., Victoria, Publ.* 6. 16. *pp.* 291–295, 1936.—The orbital elements of Boss 4217 are derived from 31 single-prism spectrograms taken in 1935. Three observations obtained at Mount Wilson Observatory in 1923 and 1924 serve to fix the period of the system with considerable accuracy. The orbital elements are $P = 3\cdot39430$ days, $e = 0\cdot025$, $\omega = 355^\circ\cdot23$, $\gamma = -16\cdot24$ km./sec., $K = 68\cdot18$ km./sec., and T = J.D. 2,428,006·493. AUTHOR.

3082. Results of Study of 48 Stellar Spectra on the Jungfraujoch in 1935. A. Arnulf, D. Barbier, D. Chalonge and (Miss) Renée Canavaggia. *Comptes Rendus*, 202. *pp.* 1488–1490, *May* 4, 1936.—[See Abstracts 1497 and 2445 (1936)].

3083. Colour Temperatures and Continuous Hydrogen Absorption of Stars of Early Spectral Types. A. Arnulf, D. Barbier, D. Chalonge and Renée Canavaggia. *Comptes Rendus*, 202. *pp.* 1571–1573, *May* 11, 1936.—The authors give (1) the mean colour temperature T_1, of Ao stars, deduced from distinct spectra of 8 stars as 11,000° K., agreeing with the 10,000° generally adopted, but differing from 18,000° of Greaves, Davidson and Martin ; (2) the colour temperature T_2 in the extreme ultra-violet of types B_0–F_5, is always greater than T_1, in accordance with Karpov's results [see Abstract 2378 (1934)] ; (3) the mean values of the discontinuity D; for super giants these values of D are less than the normal. The values given by Barbier, Chalonge and Vassy [see Abstract 2894 (1935)] are little different from the authors and accord with Unsöld's [see Abstract 1504 (1934)]; (4) they discuss the 4 exceptional stars with emission lines, γ Cass, P Cygni, υ Cygni and χ Drac, and also α Andr.

A. S. D. M.

3084. Spectral Line Intensities in O- and B-Type Stars. P. Rudnick. *Astrophys. J.* 83. *pp.* 439–475, *June*, 1936.—The author has made photometric measures of line intensities (by a method which is described) for the stronger lines of 70 Harvard Spectral types O_6 to B_9, and discusses the anomalies of neutral He and of certain differences between sharp and diffuse line spectra. HeI lines-intensity (plotted against type) have more definite maximum for dwarfs than for giants, and are enhanced in types earlier than B_3. The shift of maximum is confirmed of from B_2 in dwarfs to B_1 in giants; dwarfs and giants behave differently in the singlet-to-triplet ration, and the differences between singlets and triplets cannot be wholly due to gradient effect. Maximum-intensity of He lines shifts from sharp lines for B_2 to wide lines for B_4 stars. He confirms the marked enhancement of H in dwarfs and for this element and many others, there is no systematic difference between wide-line and sharp-line stars.

A. S. D. M.

3085. Red Spectral Region of Dwarf Stars of Class M. Y. Öhman. *Astron. Iakttagelser och Undersökning. Stockholms Obs.* 12. 3. [13 *pp.*], 1936.—The bands of MgH and CaH are strong in M dwarfs and weak in M giants [see Abstract 4467 (1934)]; AlH should resemble CaH, but the author confirms Lindblad [see Abstract 4508 (1935)] in attributing the absorption continuum to the red of the line λ4227 as due, not to AlH but to a quasi-molecule of Ca. Eastman N plates were taken of 4 typical M dwarfs (61^2 Cygni, Castor C, Groom 34 and Boss 2935) and a figure shows the abundance of CaH and AlM in dwarfs and giants. Contrary to Russell's theory, Ca and Mg are stronger in dwarfs, and this is attributed to radiation pressure on the distribution of their atoms. As a tentative explanation he indicates that cool dwarfs accumulate these elements in the photospheric and chromospheric layers; in hot giants they rise to greater heights because of low surface gravity and to these he also imputes the partial origin of interstellar Ca. Some evidence is found for the presence of ZrO bands in Groove 34, but these are weak compared with those of ρ Persei. A. S. D. M.

3086. Spectroscopic Examination of the Galactic Star-Cluster IC 2395. W. Schmitt. *Zeits. f. Astrophysik*, 12. 1. *pp.* 64–71, 1936.—The spectra of 86 stars between $5 \cdot 2^m$ and $12 \cdot 3^m$ in the south galactic star-cluster IC 2395 are determined from a classification plate obtained at the German station in Bolivia. For the evaluation of magnitudes the corrected photographic magnitudes of the Cape Astrographic Catalogue and the Cape Zone of the Chart were used. The distance of the cluster is obtained from the spectrum-magnitude diagram as 575 parsecs. (without regard to absorption). A separation of cluster-stars and field-stars is attempted. W. J.

3087. Motions of O and B Type Stars and Scale of Galaxy. J. S. Plaskett and J. A. Pearce. *Dominion Astrophys. Obs., Victoria, Publ.* 5. 4. *pp.* 241–328, 1936.—849 stars (O5 to B7) are arranged into 4 distance-groups and a general solution made for a common solar motion and K-term for all the stars, and of $\bar{r}A$ and *lo* for each group; Raymond's corrections to the Boss proper motions in declination being applied for the solar motion. The K-term has been explained as due to erroneous wavelengths, to convection currents in stellar atmospheres, to the Einstein effect, or to peculiar motions of the stars ; this latter is held by the authors since the interstellar Ca velocities give no K-term, and this medium is, therefore, at rest as compared with the stars. If the stream motion of certain southern B stars, between galactic longitudes 200° and 360°, and latitudes ± 30°, is removed and terms for the galactic rotation are introduced, the K-term becomes + 1·13 ± 0 km./sec., which is very close to the value of the Einstein displacement for the O and B stars of average mass and density. There is possibly another stream motion in the fainter B3 to B7 stars. For 13 type and magnitude groups, the mean absolute magnitudes are for Classes : O = − 4·05 ; B0, B1 = − 3·45 ; B2 = − 2·85 ; B3, B4 = − 1·50 ; B5, B7 = − 1·01. The data found for the galaxy scale are : distance of sun to centre = 10,000 p.c. ; diameter of galaxy = 30,000 p.c. ; rotational velocity of sun = 275 km./sec. ; period of rotation of sun = 220,000,000 years ; ratio of gravitational forces = 0·75 ; total mass of galaxy = $16\cdot5 \times 10^{10}$. The authors also consider the dimensions and structure of the galaxy with special regard to the distribution of globular clusters. [See following Abstract.] A. S. D. M.

3088. Dimensions and Structure of Galactic System. J. S. Plaskett. *Roy. Astron. Soc. Canada, J.* 30. *pp.* 153–164, *May-June,* 1936.—The author gives the values of diameter and thickness of the Galaxy according to Herschel, Seeliger and Kapteyn, the sun being taken as central. Shapley devised a new method by means of the Cepheid variables in globular clusters the sun being acentral and the dimensions greatly increased. These have been subsequently decreased, through a shift of the " zero-point " of the Cepheid's intrinsic luminosity and by the effect of absorption. Of this last, the author first produced direct evidence of a widely diffused gaseous medium by the interstellar H and K lines of CaII and neutral Na. The rotation of the galaxy gives a direct and independent method for finding the sun's distance from the centre [see preceding Abstract]. A plate shows a proposed model of the galaxy, and a diagram gives Shapley's distribution of the globular Cluster in 3 planes. There is confirmation of the galaxy's shape from the shape of the Andromeda nebula and its attendant globulars. The resemblance between the two is both in the spiral shape, and in surface brightness, membership and structure. A. S. D. M.

3089. Theory of Stellar Systems. B. Lindblad. *Astron. Iakttagelser och Undersökning, Stockholms Obs.* 12. 4. [64 *pp.*], 1936. *In English.*—A complete account, with mathematical detail, is given of the author's theory of the structure of the galaxy and of spiral nebulæ. The galaxy is assumed to consist of rotating sub-systems of approximately the same extension in the galactic plane but with different degrees of flattening towards this plane and different speeds of rotation at the same distance from the axis. The theory predicts a massive central system of stars surrounded by a ring-shaped region of fairly high density which appears to us as the sun's " local system." In a spiral nebula it is also found that the central system would tend to break up into spiral arms. The shape of the arms predicted is in good agreement with the shapes observed in actual spirals. In both the galaxy and the spiral nebulæ the central system contains most of the mass of the whole system and rotates with fairly uniform angular velocity. The dynamics of such a system of stars is worked out in detail in the last part of the paper. The opinion is expressed that the phenomena of galactic and nebular structure are satisfactorily accounted for on classical dynamics by deviations from the Newtonian field of force due to the flattening of these systems. G. C. McV.

3090. Galactic Rotation of Globular Clusters. F. K. Edmondson. *Roy. Astron. Soc., M.N.* 96. *pp.* 636–641, *April*, 1936.—The observed radial velocities of the globular clusters indicate that (if the orbits are circular) either: (1) The motions are evenly divided between direct and retrograde, and the inclinations deviate from a random distribution in the sense that small inclinations are favoured; or (2) the motions are nearly all direct, and the inclinations do not deviate significantly from a random distribution. Neither of these conclusions is in accord with Mineur's hypotheses [see Abstract 522 (1936)]. It is shown that Mineur's equations do not represent the observed radial velocities of the globular clusters with sufficient accuracy. The agreement between Mineur's formula for V and Oort's coefficients appears to be due to the method that was used to evaluate the constant a. The formula $V = ar + br^2 + crz^2$ is not a satisfactory interpolation formula because of its lack of flexibility. AUTHOR.

3091. Periods and Light Curves of Variable Stars in Globular Cluster, Messier 2. Helen B. Sawyer. *Dominion Astrophys. Obs., Victoria, Publ.* 6. 14. *pp.* 265–284, 1936.—Messier 2 (N.G.C. 7089) has its brightest stars of the 14th magnitude. Its first variable was discovered by Chèvremont in 1897, but this was missed by Bailey in 1902, who discovered 10 variables; the author has discovered 6 additional ones. The variables are few as compared with the normal cluster stars (about 800). Tables of observations and elements of these 17 variables, and curves, are given. Four are long-period Cepheids of which Chèvremont's has 33·6 days which is the longest known in globular cluster long-period Cepheids; Messier 2 ranks next to ω Centauri in having four such. One of the cluster-type Cepheids is a component of a double-star system. These 13 cluster-type Cepheids yield almost complete uniformity of median magnitude, and its value ($16^m\cdot07$) indicates a distance of 16 kiloparsecs—not 13·9 kiloparsecs as hitherto accepted. A. S. D. M.

3092. Distribution of Light in Globular Star-Clusters M5, M15, M92. W. Lohmann. *Zeits. f. Astrophysik*, 12. 1. *pp.* 1–39, 1936.—The distributions of brightness in these globular clusters are derived from focal-plane exposures in an 80-cm. camera. The bright and faint stars are not quite equally distributed; in particular, there are relatively fewer faint stars in the cores of the clusters. From such exposures it is impossible to determine the distribution of brightness absolutely. The extent of the change of distribution in extra-focal exposures is obtained theoretically. Finally, an estimation must be carried out so that Plummer's formula for the derivation of the space distribution of brightness gives exact results. W. J.

3093. Axial Rotation in Spectroscopic Binaries. P. Swings. *Zeits. f. Astrophysik*, 12. 1. *pp.* 40–46, 1936. *In French.*—For the majority of the short-period binaries ($P < 32^d$) for which good spectrograms were obtained at Yerkes Observatory, and of which the parallaxes are sufficiently well known, the measured rotational velocities are compared with the velocities calculated on the supposition that the periods of revolution and axial rotation are equal. In most cases the agreement is excellent. For sufficiently large periods of revolution the period of rotation becomes appreciably smaller than that of revolution. W. J.

3094. Be Spectrum Variable, χ Ophiuchi. C. H. Cleminshaw. *Astrophys. J.* 83. *pp.* 487–494, *June*, 1936.—χ Ophiuchi shows correlated changes of hydrogen velocity and emission ratio, like other Be spectrum variables. A period of about ten years seems probable. The iron emission shows a similar period, but the helium absorption is out of phase and is more irregular. The helium singlets, λ 4144 and λ 4388, give a mean velocity of 22 km./sec. greater than the helium triplets, λ 4121 and λ 4472. AUTHOR.

3095. Provisional Elements of 16 Spectroscopic Binaries. W. H. Christie. *Mt. Wilson Observat. Contrib. No.* 544. *Astrophys. J.* 83. *pp.* 433–438, *June,* 1936.—Provisional elements, derived graphically from various published lists of radial velocities, are given for 16 late-type spectroscopic binaries. AUTHOR.

3096. Spectral Variations of γ Cassiopeiæ. C. H. Cleminshaw. *Astrophys. J.* 83. *pp.* 495–506, *June,* 1936.—A study of 160 spectrograms of γ Cassiopeiae taken at the University of Michigan Observatory during an interval of 21 years (1914–1935) shows that its behaviour is characteristic of the Be spectrum variables. The hydrogen lines show a correlation between changes of radial velocity and variations in the intensity ratio of the violet to the red emission components. Observations from 1914 through 1928, like those made by R. H. Curtiss from 1911 to 1914, do not show any undoubted variation in velocity or emission ratio. Systematic changes began in 1929, resulting in a slow decrease in the hydrogen emission ratio and in the velocities of hydrogen and ionised iron. This was followed in 1932 by a more rapid increase, the violet component at the end of 1933 being more than twice as strong as the red, and the hydrogen velocity increasing by about 20 km./sec. During part of 1934 the lines were narrow and appeared single; and when both components were visible again at the end of 1934, the red one was nearly three times as strong as the violet, and there was a corresponding decrease of velocity. The behaviour of this star has been irregular, but it has been much like that of another Be star, β Monocerotis. AUTHOR.

3097. Spectrum of Nova Herculis. P. Rossier. *Arch. des Sciences,* 18. *pp.* 75–87, *March–April,* 1936.—Thirteen spectrograms of this Nova taken at Geneva between 1935 June 7, and 1935 Sept. 20, are discussed, and the lines identified. The relative importance and variation of the stronger lines are studied with the aid of breadth measurements and microphotometric analysis. The narrowness of H_β and the increase of intensity of O^{++}λ5007 are discussed. W. J.

3098. Variable Stars and Galaxies in Southern Milky Way Field. H. Shapley. *Harvard Coll. Obs., Circ. No.* 411 [14 *pp.*], 1936.—A low latitude " window " (MWF 233) covering nearly 8 square degrees between galactic latitudes − 10° to − 20°, gives as general absorption coefficient a tenth magnitude per kiloparsec. 199 new variables (clusters and long periods) were found and the most remote cluster types are as distant as the galactic centre (which is 30° away); in the same region were found 715 new galaxies, and 613 in the surrounding areas whose magnitudes, diameters and classifications are determined; in this low latitude area the number of galaxies per square degree is only a little less than that in higher latitudes of the S. galactic hemisphere; it may be abnormally rich so that the space absorption (but not more than by the loss of a single magnitude) is thus concealed. The author discusses the magnitude-diameter relation, the luminosity curves, and the frequency of types of galaxies as compared with other regions. A. S. D. M.

3099. Aberration of Terrestrial and Non-Terrestrial Objects. K. Vogtherr. *Zeits. f. Physik,* 100. 5–6. *pp.* 389–395, 1936.—According to Lorentz' theory of the stationary ether, the same optical laws hold for terrestrial and non-terrestrial objects. The fact that only heavenly bodies show astronomical aberration appears to contradict this conclusion. A simple analysis employing ordinary geometrical optics with rectilinear rays explains this apparent discrepancy without the need for special assumptions. W. S. S.

3100. Observations of Variable Stars by the American Association of Variable Star Observers. L. Campbell. *Harvard Coll. Obs., Ann.* 104. 1 [32 *pp.*], 1936.

See also Abstract 3178.

SUN.

3101. Solar Limb Effect. K. K. Mitra. *Observatory*, 59. *pp.* 160–163, *May*, 1936.—The formula of McCrea and Mitra [see Abstract 639 (1935)] involves the mean line-of-sight velocity of the atoms V. The author gives a method of estimating the relative importance of different atmospheric layers, deriving $V = V_0 (\cos \theta)^{(\gamma-1)/\gamma}$, where θ is the angle of emergence of radiation from the atmosphere and $V = V_0$ at the centre of the disc. The modified cosine law for the limb effect is therefore substantially correct for the simple model atmosphere. T. L. M.

3102. Motion of Eruptive Prominences. E. Pettit. *Nat. Acad. Sci., Proc.* 22. *pp.* 249–253, *May*, 1936.—The author confirms his previous principle that eruptive prominences rise with uniform motion, modified at intervals by sudden increases as though occasional impulses had been given them. A diagram shows a comparison of the prominences of May 29, 1919, and Nov. 14, 1934. and a Table of 38 eruptive prominences indicates that when the velocity of an eruptive prominence changes, the new velocity is a small multiple of that immediately preceding it. There seems to be little indication of a fundamental initial velocity common to all eruptions. A. S. D. M.

3103. Solar Period of 100 Years. H. Mémery. *Comptes Rendus*, 202. *pp.* 1568–1569, *May* 11, 1936.—The Cycle 1923–1933 presents a feature without example in other solar periods, for its maximum is in 1928, midway between the minima. The author examines the earlier centuries and finds for 1823–1833, and 1723–1733, the respective maxima at 1828–29, and 1728–29, but for the seventeenth century the observations are too sparse for any similar determination. [See Abstract 364 (1932)]. A. S. D. M.

3104. Equivalent Breadth of Fraunhofer Lines. M. Minnaert and J. H. Bannier. *Zeits. f. Astrophysik*, 11. 5. *pp.* 392–393, 1936.—24 lines are measured and identified between 10030 and 10540 Å of the solar spectrum. The measurements were carried out at Utrecht and full details of the results are given. G. C. McV.

3105. Damping by Collision in the Sun's Atmosphere. A. Unsöld. *Zeits. f. Astrophysik*, 12. 1. *pp.* 56–63, 1936.—The course of the equivalent breadths of the Mg series $3^1P–n^1D$ in the solar spectrum observed by Minnaert and Genard is traced to damping by collision, which originates in the phase perturbations of the excited Mg atoms by electrons or ions. The radii of action and collision-damping constants are calculated on the quantum theory. The question as to whether lines which are insensitive to Stark effect, like the D lines of Na, show damping by collision is also investigated. The effect of damping by collision on the intensities in the middles of the Fraunhofer lines is briefly discussed. W. J.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

*__3106. Electrical Prospecting by the Capacitative Method. V. Fritsch.__ *Beitr. z. angew. Geophys.* 5. 4. *pp.* 375–394, 1936.—The capacitative method of electrical prospecting has not been employed very largely, but has many possible applications. The theory of the method is discussed, and the most suitable values for capacity, self-induction and frequency of the energising system are considered. The question of representing the subterranean strata by means of an electrical network of suitable resistances, capacities and inductances is discussed, and a series of simple cases treated. The two most useful methods of measurement and the necessary qualities of the apparatus are outlined. The paper is to be completed in a subsequent article by an account of practical results obtained with this method by the author. E. L.-J.

3107. Geophysical Time Functions. J. Bartels. *Preuss. Akad. Wiss. Berlin, Ber.* 30. *pp.* 504–522, 1935.—A statistical theory of geophysical successions is worked out, which can be applied to arrays with a probability after-effect, especially to time series in geophysics. The tendency to conservation and quasi-persistence cause a considerable diminution of the observed material and changes in the usual statistical treatment, especially in proving the presence of periods. Examples are given. [See following Abstract.] W. A. R.

3108. Geophysical Cycles. J. Bartels. *Washington Acad. Sci., J.* 26. *pp.* 195–199, *May* 15, 1936.—The author recommends a thorough examination of the material by statistical methods " not only for detecting significant cycles, but even more for checking the exuberant production of cycles." [See preceding Abstract.] W. A. R.

HYDROSPHERE, PHYSICS OF THE.

3109. Scattering Daylight in the Sea. C. L. Utterback and W. Jorgensen. *J.O.S.A.* 26. *pp.* 257–259, *June*, 1936.—Measurements of the scattering and transmission of three spectral bands of visible solar radiation have been made in the San Juan Archipelago. Ratios of the scattered light to the transmitted light of each spectral band have been computed and the results shown graphically. AUTHORS.

3110. Equatorial Counter-Current. A. Defant. *Preuss. Akad. Wiss. Berlin, Ber.* 28. *pp.* 450–472, 1935.—The equatorial counter-current which flows east, is described with its yearly fluctuations for Atlantic, Pacific and Indian oceans. It is a definite member of the equatorial oceanic circulation, and lies unsymmetrically between the neighbouring equatorial currents which flow westwards. It is also clearly related to the planetary wind system, and is in part a compensation for the westward flowing water. The main cause is, however, dynamic, and arises out of the hydrodynamical conditions of the whole current system. W. A. R.

3111. Elevation of the Sea Surface under the Influence of a Travelling Low Pressure. H. Arakawa and M. Yositake. *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 51–59, *Feb.*, 1936.—Assuming the sea is of indefinite extent and of uniform depth, and that the low atmospheric pressure is in uniform rectilinear motion, exerts only normal pressure, and acts with uniform distribution over a circular area, it is found that (1) the elevation of the sea surface increases as the velocity of the low pressure approaches that of a long wave; and (2) on the outer side of the low pressure, depression is experienced front and back, and the elevation right and left. W. A. R.

3112. Deformation, Wave Patterns and Resonance Phenomena of Water Surface Due to a Moving Disturbance. Parts I and II. T. Inui. *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 60–113, *Feb.*, 1936.—The problem attacked is known as the " ship wave problem," but has previously been dealt with on the assumptions that the depth of the sea is infinite, and the moving disturbance a point source. Treating the disturbance as of finite dimensions, the problem is first worked out for finite depth, and then modified for shallow water. It is shown that the results can be applied to the disturbance of the surface by a typhoon. W. A. R.

3113. Friction in the Tidal Currents of the Bristol Channel. S. F. Grace. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 388–395, *April*, 1936.

3114. Stationary Drift Currents in the Ocean. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 6. *pp.* 105–136, *March*, 1936. *In English.*—Part I: Drift currents when the coefficient of eddy viscosity depends on the rate of gliding between successive layers. Part II: Drift currents when the coefficient of eddy viscosity depends on the square of the velocity of currents. Part III: Relation between the apparent vertical distribution of eddy viscosity and the deflection angle on the sea-surface.

3115. Seiches in a Lake. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 6. *pp.* 159–174, *March*, 1936. *In English.*—Ritz's method is applied to the integration of Chrystal's differential equation and introduces a simple method of determining seiches theoretically. AUTHOR.

3116. Free Oscillations in a Lake. I. Tuboi. *Imp. Marine Obs., Kobe, Japan, Mem.* 6. *pp.* 227–237, *March*, 1936. *In English.*—An attempt is made to solve the problem of free oscillations of water in a lake which has an irregular boundary. To treat such a problem, it has been usual to reduce it to a one-dimensional canal of varying section. A two-dimensional solution is now given. AUTHOR.

LAND, PHYSICS OF THE.

3117. Age of the Earth. J. Satterly. *Devonshire Assoc., Trans.* 67. *pp.* 35–73, 1935.—After a brief account of the astronomical and geological methods of deducing limits to the age of the earth, a detailed account is given of the radioactive method of determining the age of rocks, as deduced from the amounts of U and Th, and the amount and atomic weight of Pb present therein, with examples worked out in full. C. A. S.

See also Abstract 3127.

METEOROLOGY.

3118. Effect of Temperature on Absorption Spectrum of Ozone. E. Vassy. *Comptes Rendus,* 202. *pp.* 1426–1428, *April* 27, 1936.—The absorption coefficients of stratospheric O_3 differ from those of laboratory O_3 at 15° C. and point to a low temperature for the former [see Abstract 1124 (1936)]. Experiments here described verify that, as theoretically predicted, pressure has no part in the phenomenon, and provide accurate quantitative data on the effect of low temperature. First, the strong bands

$\lambda\lambda$ 3338–3136 are photographed in absorption by an ozonised oxygen mixture in tubes (*a*) 8·8 cm. long at 76 cm. pressure and (*b*) $8 \cdot 8 \times 40$ cm. long at 76/40 cm. pressure, *i.e.*, the atmospheric pressure at an altitude (27 km.) slightly above the middle of the O_3 layer. The two microphotometer curves obtained are identical, and the possibility of a pressure effect is thus eliminated. Secondly, the absorption coefficients of O_3 at − 80° C. for $\lambda\lambda$ 3372–3151 are measured by photographic photometry. The ratio of absorption coefficients at + 20° and − 80° C. is constant at 1·00 for all the successive absorption maxima except the double band λ 3220, but varies from 0·50 to 0·93 for the intervening minima. Comparison with the previous results indicates that about 85 % of atmospheric O_3 is at low temperature and at altitudes above 11 km. W. J.

3119. Mean and Extreme Air Temperatures. R. J. Birkeland. *Geofysiske Publ.* 14. 1. [155 *pp.*], 1936. *In German.*—Tables are given for 345 Norwegian stations of the mean and extreme air temperatures for the different months of the year over various periods. In the Introduction, methods of estimating the mean temperature are considered and explanations given of the various tables. Besides these temperature values, tables of the number of frosty days, very cold days, hot days and extremely hot days are given at various stations and deviations from the mean temperatures and probable errors are also tabulated. The number, name and geographical position of the stations and periods during which observations have been made are also given. H. M. B.

3120. Frontogenesis. S. Petterssen. *Geofysiske Publ.* 11. 6. [27 *pp.*], 1936. *In English.*—The author divides this memoir into four chapters. In the first, having given the definition of, and the criterion for, frontogenesis, he proceeds to a discussion of the general theory underlying the phenomenon. Two theorems are established: (*a*) Frontogenesis is not possible when both the field of motion and the field of property are linear fields of x and y. (*b*) Frontogenesis is only possible when the distribution of property and wind velocity along a profile (s) are such functions of s that the sum of their degrees is at least 4. The second chapter which concerns itself with frontogenesis in linear fields of motion opens with a consideration of such linear fields. The frontogenetical sector and the centre and line of frontogenesis in a field of this type are then dealt with. After a classification of possible stream line patterns a large section is devoted to a treatment of frontogenesis in various types of linear fields. These cases are illustrated by diagrams. Chapter III discusses the case when the field of property is linear. This case is, however, of secondary interest as the field cannot remain linear when v is non-linear. Frontogenesis between source regions is discussed in the last chapter. For this purpose functions are obtained to represent the fields of property and of motion. Some general conclusions are obtained on the basis of these formulæ. A. E. M. G.

3121. Ultra-Violet Spectrum of the Night Sky. A. Arnulf. *Comptes Rendus*, 202. *pp.* 1412–1414, *April* 27, 1936.—A table of the u.v. lines measured is given. The features of the spectrum are not increased in number but merely intensified by prolonging the exposure. It was not possible to measure lines or bands of wave-length inferior to 3030 Å. There is some indication that the lower limit of the continuous spectrum is at 2950 Å. G. C. McV.

3122. Polarisation of the Light of the Night Sky. I. A. Khvostikov and K. B. Panschin. *J. de Physique et le Radium*, 7. *pp.* 187–188, *April*, 1936.—Measurements were made of the direction of polarisation of the light of the night sky which is known to be partially polarised. An extinction method due to Vavilov was used. The direction of the electric vector in the polarised component tended to make a constant angle (90°) with the plane containing the direction of observation and the sun, but towards midnight a deviation occurred which reached a maximum at about 1 a.m. when the angle in question dropped to about 65°. It has previously been observed that the oxygen green line (5577·3 Å) in the night sky light exhibits a pronounced maximum of intensity at about 1 a.m., and this fact together with an assumed difference in the degree of polarisation in different parts of the spectrum of the night sky light, suggests that the observed deviation in the direction of polarisation is due to an artifact of the method having a physiological origin (variation of visual threshold with colour). W. S. S.

3123. Light Diffused by the Day Sky. V. Černiajev, I. Khvostikov and K. Panschin. *J. de Physique et le Radium*, 7. *pp*. 189–192, *April*, 1936.—Measurements made at heights of 3000 m. and 2200 m. combined with previous measurements at sea level indicate that the degree of polarisation of sky light at a given angle from the sun increases with height, and the relative energy distribution changes in favour of the blue end of the spectrum. The degree of polarisation was found to increase with decrease of wave-length down to about 4500 Å when a reverse effect set in. The possibility of explaining the results obtained in terms of secondary scattering in the atmosphere is examined. An observation indicating the possibility of a green fluorescence in the day sky under certain conditions is described. W. S. S.

3124. Transparency of the Atmosphere. J. Dufay and Tien Kiu. *J. de Physique et le Radium*, 7. *pp*. 198–204, *May*, 1936.—Plotted against λ^{-4}, the atmospheric optical densities measured at altitudes of 100 m., 1950 m. and 3260 m. in Teneriffe by Müller and Kron in 1910, give straight lines from which n_0, the number of molecules per cm.^{3} of air under normal conditions, can be determined. While, on account of humidity, the values so obtained are lower limits to n_0, certain measures at an extremely dry station at 3260 m. give $n_0 = 2{\cdot}8$ to $2{\cdot}9 \times 10^{19}$. This seems to show that the diffusion of light by gases is somewhat less than theory predicts. Deviations from the straight lines at λ 6000 make possible daily investigation of atmospheric O_3. Two series of observations begun at sunrise show that outside the O_3 selective absorption region the optical density of the atmosphere down to the horizon is proportional to mass of air. For $\lambda\lambda$ absorbed by O_3, however, the optical density increases less rapidly than mass; the altitude of the thin layer equivalent to the O_3 distribution is of the order 25 km. For elevated stations the straight lines do not pass through the origin, and the weak supplementary absorption is apparently proportional to mass of air; an explanation of this is given. W. J.

***3125. Daylight Variations. Total Illumination Photometer. W. R. G. Atkins and H. H. Poole.** *Roy. Soc., Phil. Trans.* 235*A*. *pp*. 245–272, *April* 30, 1936.—Describes the methods used and the results obtained in a study of the intensity of skylight and sunlight over a five-year period. The photoelectric cell used was a Burt sodium cell. The results are expressed in terms of the current given by the cell and this is converted to illumination values by comparison with a potassium cell standardised by using a carbon arc. A number of typical records are reproduced and a table and curve show the integral quantity of light (measured in kilolux-hours) recorded for each day in 1930. In a final section of the paper there is a description of a total illumination photometer, *i.e.*, an instrument for measuring the total illumination at a point irrespective of the direction of incidence of the light. J. W. T. W.

See also Abstracts **3010, 3107, 3108.**

SEISMOLOGY.

3126. Properties of the Time of Transmission Curve. P. T. Sokolov. *Gerlands Beitr. z. Geophys.* 47. 3. *pp.* 267–289, 1936.—The velocity of elastic waves in the earth is treated as a function of a radius vector. After obtaining an equation for epicentral distance, the hodograph is worked out and its properties examined. W. A. R.

3127. Structure of the Earth Down to the 20° Discontinuity. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 401–422, *April,* 1936.—The ordinary integral equation that gives the velocity of P and S waves requires too many doubtful assumptions for its solution. The structure of the earth above the recently discovered discontinuity at 20° is attempted by the methods for near earthquakes. The velocities of various forms of the P waves are calculated and tabulated. W. A. R.

3128. Deep Focus Earthquakes in the International Seismological Summary. S. W. Visser. *Gerlands Beitr. z. Geophys.* 47. 3. *pp.* 321–332, 1936. *In English.*—A critical examination of these records gives no support to Turner's view that the normal depth of earthquakes is 0·04R (255 km.) below the surface, though the general reliability of his depth determinations is confirmed by the long wave records. The records of 21 high focus earthquakes (1918–30) shows them all to refer to common shallow earthquakes. Bathyseisms are distributed geographically mainly on the continental side of the shallow earthquake zones of the circum-Pacific belt. There is no confirmation of a half-yearly period, but the records show a well marked annual oscillation and also imply a strong interaction between the Asiatic continent and the Pacific Ocean. C. A. S.

3129. Comparison of Seismological Stations. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 423–443, *April,* 1936. —The standard of accuracy varies from one seismological station to another. The author applies his system of weighting to all the important stations of the world, and tabulates the results. W. A. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3130. Electrical Conductivity of the Air. J. Chevrier. *Comptes Rendus,* 202. *pp.* 1602–1604, *May* 11, 1936.—Measurements of electrical conductivity were made in the daytime from Aug. to Dec. 1934, by Gerdien's method. Tables are compiled comparing the variation in the conductivity with the variation in pressure, temperature, humidity and wind. The negative conductivity shows smaller oscillations than the positive. For a closer study, the author considers that a continuous record of the conductivity is necessary. A. E. M. G.

RADIOACTIVITY.

3131. Spontaneous and Artificial Transmutations of Atomic Nuclei. K. C. Kar. *Phil. Mag.* 21. *pp.* 1067–1078, *June,* 1936.—The question of the radius of the hard core within the nucleus, where the whole of the charge is collected, is discussed, and it is shown that the wave statistical theory as developed by the author [see Abstract 139 (1934)] may be extended to explain the emission of long-range α-particles by radioactive substances, the hard core being supposed surrounded by a shell packed with large numbers of α- and β-particles, such that the net charge is zero, and circulating in a number of orbits. An α-particle on emerging from the core interacts with these circulating α-particles, and as a result an α-particle of the shell is ejected. The rate of disintegration, *i.e.*, the rate of ejection from the shell, is thence deduced, and the slightly varying velocity of the emitted particles explained. The theory is then applied to the phenomenon of artificial disintegration, and an explanation of the crossing of the potential barrier not depending on the principle of uncertainty is put forward. C. A. S.

3132. Irregular Distribution of Th C$''$. J. Zirkler. *Zeits. f. Physik,* 100. 3–4. *pp.* 203–204, 1936.—It is shown experimentally that when from a mixture of $Tl^{\cdot}$ and $Tl^{\cdots}$ (*e.g.*, sulphates) to which Th C$''$ has been added the $Tl^{\cdots}$ is fractionally precipitated by NH_3 the ratios of activity to $Tl^{\cdots}$ are constant in the successive fractions, showing that the Th C$''$ is distributed homogeneously in the $Tl^{\cdots}$, and that it is a case of chemical co-precipitation and not of being carried down by the voluminous hydroxide precipitate. C. A. S.

3133. Stopping-Power of Mica for α-Particles. W. E. Bennett. *Roy. Soc., Proc.* 155*A*. *pp.* 419–434, *June* 2, 1936.—The stopping-power of mica for α-particles is determined by two methods, by measuring the change of velocity by magnetic deflection and by direct range measurements in dry air. The two sets of measurements agree in showing that the ratio of superficial mass to stopping-power varies by 2–3 % for different pieces of mica. The different values of stopping-power and of variation of stopping-power with range are averaged and used to calculate stopping-power-range curve for mica. In the course of the work, curves are obtained for the velocity straggling of α-particles in mica. These are definitely Gaussian, and give values of the straggling coefficient 1·1 times the values calculated from Bohr's theory. AUTHOR.

3134. Effect of Screening in the Theory of β-Disintegration. M. E. Rose. *Phys. Rev.* 49. *pp.* 727–729, *May* 15, 1936.—The possibility is considered that screening by the atomic electrons has an appreciable effect on the energy distribution of β-particles emitted by heavy nuclei. A general formula is derived from which it is possible to conclude that the effect of screening is negligible. This result is also derived by another method. Finally, an explicit calculation based on the model of a charged sphere is shown to lead to the same conclusion. AUTHOR.

3135. Emission of γ-Radiation during the β-Decay of Nuclei. J. K. Knipp and G. E. Uhlenbeck. *Physica,* 3. *pp.* 425–439, *June,* 1936. *In English.*—Experimental investigations show that the disintegration of RaE is accompanied by a fairly weak γ-radiation. Theoretical calculations are made which show that a large part, if not all of this radiation arises from the creation of the electron and its loss of energy as it leaves the nucleus. This process is an " inner " (to be contrasted with the " outer ") *Bremsstrahlung* due to the impingement on the nucleus of electrons coming from the outside. It has the order of magnitude $\alpha = 1/137$ per outcoming electron. Two methods of treating the problem are employed and it is found that in the Born approximation they give identical results. In the first the electron is represented by the free, out-going, not-allowed, spherical solutions of the Dirac equation and radiation transitions are calculated to standing waves. In the second method the calculations are based on the Fermi theory of β-decay. The effect of a quantised electromagnetic radiation field is introduced by means of a coupling term between the electrons and the radiation field. Radiation intensity curves are obtained which are very similar to those for ordinary *Bremsstrahlung*. AUTHORS.

3136. Theory of β-Radioactivity. B. Kahn. *Physica*, 3. *pp*. 495–502, *June*, 1936. *In English*.—Criticism is given of Wick's explanation [see Abstract 2959 (1935)], on the basis of Fermi's theory of β-radioactivity, of the magnetic moment of the proton and the neutron. It is shown that with the Fermi interaction Ansatz the magnetic moment due to the electron-neutrino field is exactly zero. This is due to the fact that the spin of the heavy particle does not change during a β-emission. An estimate is given of the neutron-neutron forces in relation with the proton-neutron interaction. AUTHOR.

3137. Internal Conversion Coefficient for γ-Rays. H. R. Hulme, N. F. Mott, F. Oppenheimer and H. M. Taylor. *Roy. Soc., Proc.* 155*A*. *pp*. 315–330, *June* 2, 1936.—A summary is given of the theoretical results obtained in the theory of the internal conversion of γ-rays, and the various sources of error are discussed. The theory is compared with the available experimental material. The results are shown to lend support to the hypothesis that soft γ-rays correspond to transitions between the states of a nuclear multiplet. AUTHORS.

See also Abstracts **2924, 2929, 2931, 2936, 2939, 3117, 3183, 3185, 3300, 3336, 3337, 3338, 3339.**

RADIATION.

ABSORPTION AND TRANSMISSION.

3138. Transmission of Light through a Pile of Parallel Plates. R. A. Hull. *Phys. Soc., Proc.* 48. *pp.* 574–575, *July* 1, 1936.—The transmission of light through a pile of transparent plates is calculated by a simple method which gives incidentally the fractions of transmitted and reflected light passing at any surface in the system. AUTHOR.

***3139. Light Filters for Infra-Red. R. B. Barnes and L. G. Bonner.** *Phys. Rev.* 49. *pp.* 732–740, *May* 15, 1936.—A Christiansen filter consists of a powder of some crystalline or glassy material suspended in a transparent medium. At the wave-length for which the refractive index of the solid is equal to that of the medium, the transmission curve of the filter has a maximum which under certain conditions may be quite sharp. The theory of the effect and methods for preparing filters suitable for use in the infra-red are described in the paper. Experimental results given include transmission curves for the following materials in air: quartz, MgO, calcite, marble, $CaSO_4$, 11 alkali halides and 3 thallium halides. Curves are also given for quartz, MgO and NaCl in organic liquids. The maxima lie between 3 and 90 μ. Finally, the authors discuss various possible applications of the Christiansen effect, including spectrometry in the far infra-red and the study of the refractive indices of crystals. J. W. T. W.

See also Abstracts 2966, 3181.

COLORIMETRY.

***3140. Precision Photoelectric Colorimeter. R. B. Withrow. C. L. Shrewsbury and H. R. Kraybill.** *Indust. and Engin. Chem.* (*Analytical Edition*), 8. *pp.* 214–219, *May* 15, 1936.—After a description of the characteristics of various types of photo-cells and the ways in which they may be used in a colorimeter, the author describes an instrument incorporating two cells of the emission type (Cs_2O, vacuum cells). It was found that the cells were accurately linear in response and data are given on the constancy of calibration over a period of six months, and on the probable spread of individual measurements obtained at any given time. The accuracy claimed for measurements of transmittance is about 1 % with a reproducibility of 0·1 %. J. W. T. W.

See also Abstract 2966.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

3141. Refractivity and Magnetic Birefringence of Liquid Mixtures. M. Ramanadham. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 384–397, *April*, 1936.—The two outstanding features which Chinchalkar and other workers observed in the study of the magnetic birefringence of liquid mixtures are explained quantitatively by introducing the new idea of a varying set of anisotropic polarisation field coefficients. The actual variations which the coefficients undergo with changing concentration are determined from the observed refractivities of mixtures of the requisite composition. Although only typical mixtures are dealt with in detail in this paper, the general conclusions hold good in all the mixtures so far studied. AUTHOR.

3142. Magneto-Optical Rotation and Natural Dispersion in Gases. R. T. Lageman and F. G. Slack. *Phys. Rev.* 49. *pp.* 807–809, *June* 1, 1936.—Formulæ for the natural dispersion and for the magnetic rotation are tested together by use of recently determined data for gases. Similar checks have been made by Evans and his co-workers for liquids. Dispersion equations of the Ketteler-Helmholtz type, with a single u.v. absorption term, together with Becquerel's equation for the Verdet constant are found to fit the experimental data in the case of the gases, C_2H_2, C_2H_4 and CO_2. The computed wave-lengths of absorption bands lie within the experimentally determined bands for these gases. Other constants of the two equations are also computed. For several other gases, CH_3Cl, $CHCl_3$, O_2, N_2 and H_2, apparently more complicated formulæ are required. AUTHORS.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

3143. Applications of Ultra-Violet Light and Some Aspects of Fluorescence and Phosphorescence. F. E. Lamplough. *Illum. Eng. Soc., Trans.* 1. *pp.* 69–74; *Disc.*, 74–79, *May*, 1936.—The main phenomena of fluorescence and phosphorescence, and in particular those obtainable by excitation with u.v. light, are described together with a number of applications including the examination of palimpsests, testing forged documents and pictures, production of stage and film "effects," chemical analysis, etc. In the *Discussion*, **L. Levy** describes the production of materials having the fluorescent or phosphorescent properties required in different applications. W. S. S.

3144. Direct Evidence of the Bimolecular Scheme of Phosphorescent Decay. V. Antonov-Romanovskij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 2. 3. *pp.* 97–100, 1936. *In German.*—In the simplest case the bimolecular theory gives the decay rate as $I = I_0 (1 + pn_0t)^{-2}$, $I_0 = p \cdot n_0^2$, where t is the time, n_0 the concentration of ions or electrons at the start, and p is the probability of recombination of ions and electrons. It has been objected that often the decay of a phosphor does not follow this law. It can be shown, however, that with very general and simple assumptions based still on the bimolecular theory, this formula may give way to others. For, the probability of recombination will actually become smaller with time, since if it is assumed that the probability is greater for ions and electrons close together, the number of close neighbours will fall off with time and the rate of decay will actually be slower and slower than the above formula gives with constant p. It is shown that it follows from the bimolecular theory that the initial intensity with momentary illumination is proportional to the square of the illumination. This has been confirmed with a number of ZnS(Cu) phosphors. J. E.

3145. Extinction of Luminescence of Substances with Organic Activators. L. Vinokurov and V. Levšin. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 2. 4. *pp.* 135–138, 1936. *In French.*—The authors have worked with the phosphors discovered by Tiede and by Travnicek, *i.e.*, boric acid activated by uranine, eosin, etc., and $Al_2(SO_4)_3 \cdot 18\,H_2O$, similarly activated. They find that the law of decay is given by $I = I_0 \cdot e^{-t/\tau}$ exactly. The order of brightness with various activators is the same as in aqueous solution. It is considered that the decrease of intensity with high concentrations is due to interaction between excited and unexcited activating molecules. J. E.

See also Abstract 3153.

INTERFERENCE. DIFFRACTION AND SCATTERING.

3146. New Interference System at a Dusty Mirror. M. Renninger. *Zeits. f. Physik*, 100. 5–6. *pp*. 326–334, 1936.—It is shown that at a dusty mirror a hitherto unrecorded type of interference ring system is formed in addition to the Haidinger and Quetelet rings. This arises from the interference of a ray scattered at the dusty surface with a ray which has passed undeviated through the dusty surface, has been reflected, then scattered backwards from the dusty surface and then re-reflected from the reflecting surface. The most noteworthy property of the system is that on rotation of the mirror the rings remain stationary, unlike the Haidinger system which turns at the same rate as the mirror, and the Quetelet system which turns twice as fast as the mirror. The Haidinger system is imaged at infinity, a virtual image of the Quetelet system is formed at the mirror-image of the light source, while a real image of the new system is formed on the same side of the mirror as the light source. D. H. F.

3147. Multiple Sets of Fringes in the Michelson Interferometer. I. Walerstein and R. A. Woodson. *J.O.S.A.* 26. *pp*. 267–271, *June*, 1936.—By using an unsilvered dividing plate in a Michelson interferometer or an intense source with the usual half-silvered plate several groups of interfering rays are produced due to internal reflections in the dividing and compensating plates. These lead to four distinct sets of interference fringes whose shapes change with variations of the distances and angles between plates and mirrors. They are circles, ellipses, straight lines and double sets of hyperbolæ. AUTHORS.

3148. Diffraction by Body with Surface of Revolution. P. Barreca. *Arch. des Sciences*, 18. *pp*. 88–99, *March–April*, 1936.—A solution of the general equation by classical procedure for the particular case of a black body *in vacuo* and a point source of monochromatic light radiating equally in all directions, including the case of the sphere. W. J.

3149. Variation of Intensity of Scattered Light with Temperature. C. V. Jogarao. *Indian Acad. Sci., Proc.* 3A. *pp*. 377–383, *April*, 1936.—The intensity of scattering is found to increase with temperature in benzene and acetic acid and to decrease with rise in temperature in nitrobenzene and formic acid. Such differences in the behaviour of these liquids are only apparent and are attributed to the fact that the scattered beam is ordinarily an admixture of two types, viz. density scattering, and orientation scattering. When the aggregate intensity is suitably separated into these two constituent parts, the density scattering is always found to increase with increasing temperature as should be expected whereas the orientation scattering sometimes increases (e.g. benzene) and sometimes decreases (e.g. nitrobenzene, acetic acid and formic acid). The observed effect is an aggregate of these two phenomena. AUTHOR.

3150. Asymmetrical Scattering of Light in Turbid Layers Subjected to Mechanical Shear. H. A. Schwarzenbach. *Helv. Phys. Acta*, 9. 4. *pp*. 301–305, 1936. *In German*.—A description is given of experiments designed to demonstrate that the normally symmetrical directional distribution of light-scattering in a layer of vaseline between two glass plates becomes asymmetrical when one plate is slid relative to the other. If the direction of motion be reversed, a momentary increase of scattering is observed at the reversal. It is shown that the asymmetry is probably analogous to the phenomenon of double refraction due to flow, and is caused by hydrodynamic stresses set up in the layer. Photographs of the effect are reproduced. L. A. W.

***3151. New Type of Interferometer. A. Hoyt.** *J.O.S.A.* 26. *pp.* 262–266, *June,* 1936.—A description is given of an extremely simple interferometer which is easy to construct and adjust. It is admirably suited to the measurement of small displacements. It can be adjusted and used with either monochromatic or white light. Each of the small, light mirrors used needs only one optical surface. The sensitivity can be increased by using multiple reflections without unnecessary loss of intensity, since the surfaces are all fully aluminised. Tests on the interferometer have shown that it is capable of detecting displacements of $\lambda/2n$ where λ is the average wave-length of the light used and n is the number of reflections from the moving mirror (nearly normal incidence). Under best (easily attainable) conditions 14 reflections can be obtained, whence a shift of 1 fringe would correspond to $\lambda/28$. Extreme care in the preparation of optical parts might yield 20 reflections and a displacement sensitivity of $\lambda/40$ for each fringe shift. A compound multiple reflection interferometer is also described which gives twice the sensitivity mentioned above. AUTHOR.

***3152. Photographic Method for Producing Echelons and Gratings on Curved Surfaces. F. Burmistrov.** *Techn. Phys., U.S.S.R.* 3. 3. *pp.* 258–265, 1936. *In French.*—A photographic method for producing echelons and gratings on a cone or on surfaces of revolution of conic sections, based on an extension of Czapski's theorem, is described. C. B. A.

See also Abstracts 3275, 3280.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3153. Photodissociation of Gallium Halides. A. Petrowa. *Acta Physicochimica,* 4. 4. *pp.* 559–566, 1936. *In English*—Examines the fluorescence and photodissociation of monovalent GaI and GaBr vapours. On irradiation of the GaI vapour with the non-decomposed light of Al, Zn and several other sparks a violet luminescence is obtained, beginning to appear at a tube temperature of 200° C. and reaching a maximum value at 300°C. This luminescence is not a resonance luminescence, the upper limit of the excitation radiation being 2080 ± 20 Å, and giving the value of 66 ± 1·1 k.cal./mol. for the heat of dissociation. A yellow fluorescence can also be detected at a tube temperature of 150° C. with exciting light of low wave-lengths. A greyish-green fluorescence is obtained when vapours of GaBr are irradiated with non-decomposed light from an Al spark, the upper limit of the excitation radiation being apparently 1725 ± 100 Å and the maximum intensity occurring at a tube temperature of 230° C. A comparison of the heats of dissociation of monovalent Ga halides with analogous Tl halides shows that those for the Ga salts are higher although the ionisation potential of Ga is smaller than that of Tl. R. C. F.

3154. Photochemical Reaction between Bromine and Water. H. A. Pagel and W. W. Carlson. *J. Phys. Chem.* 40. *pp.* 613–617, *May,* 1936.—The reaction velocity equation is found, and a reaction mechanism shown to be in logical agreement with it is discussed. AUTHORS.

3155. Dissociation of Excited Iodine Molecules. E. Rabinowitch and W. C. Wood. *J. Chem. Phys.* 4. *pp.* 358–362, *June,* 1936.—By means of a sensitive optical method described elsewhere [see Abstract 1604 (1936)] the quantum yield of the process $I_2 + h\nu \rightarrow I + I$ was determined in mixtures of I_2 vapour with several hundreds of mm. of He, A, H_2 and N_2, in three spectral regions: (1) In the continuum, *i.e.*, on the short wave-length side of the convergency limit at 4990 Å; (2) in the band region immediately behind this limit, on its long wave-length side; and (3) in the band region further away from the limit. If the quantum yield is assumed to be $\gamma_1 = 1\cdot 00$ in the first region, the values $\gamma_2 = 1\cdot 14$ and $\gamma_3 = 1\cdot 10$ are obtained for the two other regions, showing that all excited I_2 molecules dissociate by collisions with foreign molecules. The quenching of I_2 fluorescence by foreign gases is thus practically never due to the dissipation process (1) $I_2^* + X \rightarrow I_2 + X$ but entirely to the dissociation process (2) $I_2^* + X \rightarrow I + I + X$. The process (2) apparently occurs in most cases at the very first kinetic collision of excited iodine with a foreign molecule; only in the case of helium ten or more collisions are necessary to produce dissociation according to (2). AUTHORS.

3156. Characteristic Curve of the Photographic Plate. R. A. Houstoun. *Phil. Mag.* 21. *pp.* 1113–1119, *June*, 1936.—Suggests an equation for the characteristic curve of the photographic plate from an examination of data previously published. The equation is a two-constant instead of the three-constant formula given by Silberstein, but it appears to fit the results better in every case except one. R. C. F.

3157. General Photographic Density Law. A. van Kreveld and L. S. Ornstein. *K. Akad. Amsterdam, Proc.* 39. 4. *pp.* 477–484, *April*, 1936.—Derives mathematically two laws, one of which can be considered as the most general density law for monochromatic radiations, the other being the most general density law for arbitrary radiations. The density law for monochromatic radiations contains only two constants dependent on the wave-length, three others being characteristic of the emulsion. Differences between the two laws show clearly that the density law for mixed colours is essentially different from that for monochromatic colours. R. C. F.

3158. Theory of Photographic Development. Part III. A. J. Rabinowitsch and S. S. Peissachowitsch. *Acta Physicochimica*, 4. 5. *pp.* 705–728, 1936. *In German.*—The fundamentals of the adsorption theory of photographic development described previously [see Abstract 4519 (1934)] are amplified by a description of a simple model of the latent image and of its development. The emulsion grains of the AgBr are replaced by colloidal AgBr particles and the nuclei which appear on exposure by colloidal Ag particles which have been added to the AgBr. Addition of a basic hydroquinone solution causes a rapid darkening of the mixture as a result of reduction of the AgBr; *p*-aminophenol, metol, amidol and other developers act in the same way but at different velocities. Colloidal Pt, Au and Cu also cause development. All colloids which affect development with hydroquinone in the manner stated also adsorb hydroquinone and those which do not adsorb do not develop. The Ag particles are intimately bound up with the AgBr particles, and move with them in electrical and gravitational fields. Introduction of gelatin before the addition of the colloidal Ag results in no development. Thus, important conditions for development are adsorption of the developer by the metal particles and intimate contact of the latter with the bromide particles. These conditions are in complete agreement with the postulates of the adsorption theory of development. The application of the adsorption model to a study of the numerous factors in development, such as the number and size of the nuclei of the latent image, the pH of the medium and the concentration of the solutions, is briefly described. H. J. H. S.

3159. Electrochemical Theory of Photographic Development. J. E. de Langhe. *Physica*, 3. *pp.* 398–406, *June*, 1936. *In German.*—Based upon the solution-saturation theory of photographic development the author investigates theoretically the relationship between the rate of development (m) and the potential difference, $\Delta E = E_{Ag} - E_{red}$, for the case of a monovalent developing ion (*e.g.*, the ferrous ion). In the calculations the solution velocity of the silver halide comes into consideration. It is shown that the curve (m, ΔE) exhibits a maximum in the positive region (maximum rate of development at $\Delta E = \infty$) and a minimum in the negative region (maximum rate of fading at $\Delta E = -\infty$). The null point tangent to this curve is independent of the rate of solution of the silver halide. The reaction constants k and k^1Ag may easily be calculated from the value of this null point tangent and the electrochemical data. The rate of development in the vicinity of the null point is found to be a linear function of the logarithm of the halogen ion concentration of the developing liquid. The paper is entirely theoretical, but the results are in complete agreement with Reinder's experimental data. [See Abstract 4160 (1934).] H. H. Ho.

3160. Bichromate Gelatins. Part III. E. Elöd and H. Berczeli. *Kolloid Zeits*, 75. *pp.* 202–211, *May*, 1936.—In this work the authors have endeavoured, for two commercial gelatins which exhibit a large difference in their apparent sensitivity to light, to separate the photo-reaction and the tanning capacity. Influence of the photo-reaction by the individual kinds of gelatin could not be established. On the other hand, the photo-reaction is dependent on the water content of the gelatin films in which, with decreasing content the amount of altered chrome-6-compound is increased. The solubility of the pure gelatin film could not be reduced by irradiation, and dehydration was found not to be a cause of tanning. It appeared, however, that the differences of the apparent sensitivities to light under equal conditions were solely dependent on the tanning reaction of the separate gelatins. The tanning reaction of the gelatins was investigated, by following the solubility decrease with increasing amounts of added chrome-3-compound, in the form of the so-called tanning curve, and a quantitative relationship was established and expressed by the equation, $\log L_{Cr} = \log L_0 + 10\ (Cr - Cr_0)\ tg\ \alpha$, where L_0 = solution period without addition, L_{Cr} = solution period for a given content of Cr, Cr = added $Cr^{\cdot\cdot\cdot}$ as a percentage, C_0 = an estimated constant from the curves, and α = angle of inclination of certain logarithmic lines. The constants in the equation are related to the dark-tanning and to the apparent photo-sensitivity. [For Part II see Abstract 2690 (1936).] H. H. Ho.

3161. Monochrome Reproduction in Photo-Engraving. A. Murray. *Kodak Research Lab., Comm. No.* 585. *Frank. Inst., J.* 221. *pp.* 721–744, *June*, 1936.—A purely photographic process of multi-colour plate-making cannot be realised unless it gives a practically perfect monochrome of the density scale on each plate. It is necessary to determine whether perfect reproduction of a density scale is experimentally possible in the half-tone processes, and the scope of the present work is limited to the formulation of a dependable routine for producing perfect plates. The results obtained show that ink spreading has a greater effect upon the reproduction curve than variations in ink density, and a plate will yield perfect proofs only with a specific ink density and a specific amount of ink spread. A straight line reproduction with an ink of one D_{max} will retain its straight line form for changes in ink density up to ± 0·3. Micrometric data enables accurate forecasting of reproduction curves of proofs on smooth paper, based on specific spreading increments and specific ink densities, and accurate determination of the linear dimensions of all dots to be made. Certain other necessary quantities can, however, be calculated from definite measurements. It is possible to specify under what conditions a particular plate will yield a proof giving a perfect reproduction curve. Micrometry being too laborious, it is more efficient directly to measure densities, and density measurements on the structured image of the proof agree accurately with micrometric calculations from either plate or proof. Finally, the curve of perfect reproduction for the structured image of a half-tone proof is the same as that for photography with unstructured images. R. C. F.

See also Abstracts 2943, 2969, 3166, 3226, 3233, 3240, 3252, 3262.

PHOTOMETRY.

3162. Visual Photometry. R. Sewig. *A.T.M.* 5. *T*60–*T*61, *May*, 1936.—A general *résumé* of the characteristics of the eye, as they affect brightness comparisons. This is followed by a description of the principles which may be employed in photometric apparatus, *e.g.*, flicker, contrast comparison, extinction methods, visual acuity, etc. A final section is devoted to the precautions necessary in visual photometry. J. W. T. W.

***3163. Electron Output in Photon Counters. W. Christoph.** *Phys. Zeits.* 37. *pp.* 265–269, *April* 15, 1936.—A special photon counter is described which incorporates a device by which the field near the outer cylinder, which acts as the kathode, can be locally intensified. That this local intensification does not introduce any instability in the counting conditions is shown by the fact that it does not affect the counting rate in the dark. Its effect is, however, to reduce the proportion of photoelectrons which diffuse back towards the kathode. Results show that the counting rate increases as the local intensification of the field increases, the increase being greater the smaller the difference between the wavelength of the exciting radiation and the threshold wave-length. Hence it is concluded that in an ordinary counter only a proportion of the emitted photoelectrons initiate a discharge. D. H. F.

3164. Talbot's Law in Photoelectric Photometry. G. A. Boutry. *Comptes Rendus*, 202. *pp.* 1580–1582, *May* 11, 1936.—Experimental results are quoted to show that Talbot's law is not obeyed by photoelectric cells in general. The extent of departure from the law increases with decreasing aperture of the rotating sector, and may not be in the same sense for different cells. The departure is greater for gasfilled than for vacuum cells; it appears to be related to the nature of the kathode and many amount to several per cent. For a given aperture the departure varies slightly with the speed of rotation of the sector. D. H. F.

3165. Photoelectric Photometry of Narrow Beams. E. Ganz. *Zeits. f. Astrophysik*, 12. 1. *pp.* 76–77, 1936.—Irregular behaviour of the photoelectric current is observed in an application where a gasfilled photo-cell is used to measure the intensity of a narrow pencil of monochromatic light, little more than $0 \cdot 1 \times 4$ mm. in section, in the near infrared, the area illuminated varying successively from one wave-length to another. The irregularity disappears when the kathode is continuously illuminated over the whole of its surface by white light of low intensity producing a current of about 5×10^{-8} A, which is about 10–20 times as great as that due to the monochromatic beam. The constant current is balanced out by an auxiliary circuit so that the superimposed current due to the monochromatic beam can be read directly. D. H. F.

3166. Photographic Photometry in Far Ultra-Violet. Renée Herman-Montagne, L. Herman and R. Ricard. *Comptes Rendus,* 202. *pp.* 1668–1670, *May* 18, 1936.—The characteristics of photographic plates coated with sodium salicylate [see Abstract 2230 (1936)] are investigated. Over the range 1808-718 Å the characteristics have the same slope, within 6 %, and are similar in shape. In plates in which the gelatin base is destroyed by the action of H_2SO_4 the slope of the characteristic is very much less than that of the salicylate-sensitised plate, but the sensitivity to low intensities is considerably greater. D. H. F.

See also Abstract 3125.

POLARISATION.

3167. Anisotropy of the Optical Polarisation Field in Liquids. Part III. *Indian Acad. Sci., Proc.* 3*A. pp.* 369–376, *April,* 1936.—The molar refractivity is found to increase with temperature in nitrobenzene and diminish, although only slightly, in the case of water. In the cases of acetic and formic acids, it increases up to a certain temperature and then begins to diminish. The coefficients of anisotropy of the optical polarisation field are calculated in the cases of acetic acid and nitrobenzene. In the former, the polarisation field becomes more and more anisotropic whereas in the latter it becomes more and more isotropic with increasing temperature. [For Parts I and II see Abstract 2699 (1936).] AUTHOR.

***3168. Polarising Characteristics of Polaroid Plates for Wave-Lengths 4000 Å to 20,000 Å. L. R. Ingersoll, J. G. Winans and E. H. Krause.** *J.O.S.A.* 26. *pp.* 233–234, *June,* 1936.—The polarising property of the new Polaroid plates is found to be limited almost entirely to the visible spectrum, dropping off very rapidly in the infra-red and violet regions. AUTHORS.

See also Abstract 3008.

RADIATION, EMISSION.

***3169. Theory of the Chronostat and Wien's Law. T. Takéuchi.** *Phys. Math. Soc. Japan, Proc.* 18. *pp.* 131–132, *March,* 1936. *In French.*—The author proposes to derive Wien's law for white-body radiation, emitted by an imperfect gas in a hot inner chamber, from the point of view of the theory of the chronostat. S. G. B.

3170. Tables of Emissivity of Tungsten as a Function of Wave-Length from $0 \cdot 23$–$2 \cdot 0$ μ and 1600°–3000° K. L. S. Ornstein. *Physica,* 3. *pp.* 561–562, *June,* 1936. *In English.*

3171. Secondary Cosmic Radiation at 2300 m. Altitude. J. A. Priebsch. *Akad. Wiss. Wien, Ber.* 145. 2*a*. 1–2. *pp.* 101–144, 1936.—Observations were taken on the Hafelekar using a triangular formation of three counters beneath various thicknesses of Pb and Fe. The curve of coincidence-frequency against thickness showed a linear increase to the maximum (at 1·6 cm. for Pb and 5 cm. for Fe), and an exponential falling off after the maximum. A secondary maximum at 17 cm. was found with Pb. Observations were taken over a period of two months with 1·8 cm. of Pb. The variations followed those of ionisation chamber and vertical intensity measurements, but were more marked. Hence it is concluded that a soft component is responsible for the observed coincidences. The variation with barometric pressure was greater at 2300 m. than that at 600 m., and it is hence concluded that the exciting radiation has an extended energy spectrum. A detailed derivation of the correlation between coincidence-frequency variations with pressure and temperature variations is given. D. H. F.

3172. Absorption of Primary Cosmic Rays in Various Materials. J. Clay. *Physica,* 3. *pp.* 332–340, *May,* 1936. *In English.*—The decrease of ionisation by cosmic rays under thick layers of iron and steel was measured and compared with former results in water and air. Equilibrium between the primary radiation and the secondary effects was found to occur under layers of more than 400 gm. per cm^2. Under such layers the decrease in lead, iron and water is proportional to the density. This is an indication in favour of the corpuscular nature of the primary radiation. The coefficient is 0·00044 per $gm./cm^2$. In the atmosphere the mass coefficient of decrease is about ten times larger. This is considered to show that there are two independent kinds of primaries both of which produce showers. It is suggested that the hard component consists of protons and the soft component of electrons. The energy necessary to penetrate the atmosphere is then about 4×10^9 eV for protons and about 10^{10} for electrons. J. J. S.

3173. Absorption of Cosmic-Ray Showers in Lead. C. G. Montgomery and D. D. Montgomery. *Phys. Rev.* 49. *pp.* 705–711, *May* 15, 1936.—The absorption in lead of the shower rays which produce the bursts of cosmic-ray ionisation is measured by two methods. The first method consists in observing the ionisation produced above and below a lead absorber placed across the centre of an ionisation chamber; the second is to observe the probability that a burst of ionisation in a chamber is accompanied by a simultaneous discharge of three Geiger-Muller counters over one of which has been placed an absorber. The results of the two methods are in good accord and may be stated in the form that the probability that a ray of a shower will penetrate a thickness of lead decreases linearly with the thickness, becoming zero at approximately 11 cm. The experiments serve to emphasise again the high energies that are involved in a large shower. The results are applied to observations on the effect of shielding on the ionisation observed in the stratosphere. AUTHORS.

3174. Coincidence Counter Studies of Cosmic-Ray Showers. R. H. Woodward. *Phys. Rev.* 49. *pp.* 711–718, *May* 15, 1936.—It is found that the production curves (counting rate against thickness of lead) of electron-produced and of photon-produced showers are similar and that the average penetrating power of the rays from electron-produced and from photon-produced showers is the same. Shower production curves are obtained at four elevations and analysis of the curves shows that the absorption per nucleus of the shower-producing radiation (photons) is approximately proportional to the square of the atomic number. Coefficients for lead (0·33 $cm.^{-1}$), iron, and air are determined, and a comparison with theory is given. Also the penetrating power of the shower rays emerging from a block of lead is measured and found to be independent of the elevation and of the thickness of the lead from which the rays emerge.

Author.

3175. Geomagnetic Analysis of Cosmic Radiation. G. Lemaitre and M. S. Vallarta. *Phys. Rev.* 49. *pp.* 719–726, *May* 15, 1936.—The results of an extensive study of trajectories asymptotic to a certain family of periodic orbits in the earth's magnetic field, carried out by means of Bush's differential analyser, are presented. The theory of the region of full light, or main cone, is fully discussed. Attention is then restricted to the section of the main cone in the plane of the geomagnetic meridian and it is shown that the N-S asymmetry furnishes the most direct approach to the analysis of the energy spectrum in a wide approach to the analysis of the energy spectrum in a wide region, independently of the particles' sign. Further it is shown that the general shape and the minimum of the N-S asymmetry discovered by Johnson in the course of his Mexican experiments are fully accounted for by the action of the earth's field. Authors.

3176. Compensation by Uranium in Cosmic-Ray Ionisation Measurements. K. H. Strauss. *Zeits. f. Physik*, 100. 3–4. *pp.* 237–249, 1936.—This paper describes a simple method of using the ionisation due to U to compensate cosmic-ray ionisation in long period measurements with an ionisation chamber. An ionisation chamber was fitted up in turn with this arrangement and with a modification of the orthodox electrical compensation method, and a comparison was made of the accuracy of the determination of cosmic-ray intensity variations over long periods by the two methods. It is concluded that the U compensation method affords the greater accuracy. D. H. F.

3177. Penetrating Radiation Measurements in Deep Water. E. Regener. *Zeits. f. Physik*, 100. 5–6. *pp.* 286–292, 1936.—The author points out that when measuring weak ionisation effects errors arise owing to the radioactivity of the dry cell used in the apparatus, and indicate how this may be overcome. The measurement of penetrating radiation under deep water is discussed. J. E. R. C.

3178. Extra-Terrestrial Effects of Cosmic Rays. F. Zwicky. *Nat. Acad. Sci., Proc.* 22. *pp.* 266–270, *May*, 1936.—There are three radiations in interstellar space: (1) light from the stars; (2) atomic rays ejected from Novæ, Wolf-Rayet stars, etc., possessing individual kinetic energies as high as 10^7 eV; (3) cosmic rays with energies of 10^9 eV and more. The gap between these two energies is filled by a variety of rays which may be either low energy cosmic rays or atomic rays more energetic than those emitted from bright common Novæ. For such, observations are needed of Novæ brighter than $M_{vis} = -9$, and of the non-polar auroræ. For the excitations of emission lines by cosmic and by atomic rays, the author cites as most favourable the tenuous atmospheres of giant stars, the interstellar gas cloud, comets' tails, etc., and discusses giants of low surface temperature (2000° K.), suggesting that Mira stars emission lines may be produced by energetic interstellar rays; from the transfer of mechanical momentum from atomic and cosmic rays to stellar and interstellar matter, he finds that in contradistinction to atomic rays, cosmic rays tend to disperse in course of time all local accumulations of interstellar gases. Both cosmic and atomic rays are ejected and re-collected by stellar systems, completing a cycle which may influence the evolution of stars and galaxies. [See Abstracts 2804 (1934) and 2176 (1936).]

A. S. D. M.

3179. Transition Effect of Cosmic Radiation on Entering Atmosphere. B. Gross. *Phys. Zeits.* 37. *pp.* 409–412, *June* 1, 1936.—On the assumption that the production of secondary radiation is proportional to the energy of the primary particles an equation is developed for the variation of cosmic radiation intensity with increasing depth at the top of the atmosphere. Satisfactory quantitative agreement is obtained with the observed transition effect which occurs while the primary particles are reaching equilibrium with their secondaries. D. H. F.

3180. Energy Transmission by High-Energy Electrons. W. F. G. Swann. *Phys. Rev.* 49. *pp.* 829–830, *June* 1, 1936.—In considering the theory of energy transfer at close collisions between charged particles, one of which is of high energy, J. R. Oppenheimer [see Abstract 713 (1935)] has postulated the condition that in calculating the effect of the field of the high-energy particle, one must omit from its appropriate Fourier analysis all of those harmonic terms whose frequency lies above a certain critical value characteristic of the charged particle acted upon. Some time ago, the writer proposed a modification of the fundamental wave-mechanical equation which was designed so as to lead statistically to the classical equation of motion of an electron including the so-called radiation reaction terms. It is now shown that the Oppenheimer condition is a direct analytical consequence of the modified wave-mechanical equation referred to. The significant feature of the matter is that the terms which in Oppenheimer's postulate are simply omitted are, on the writer's theory, rendered automatically impotent by having associated with them large denominators which kill their effects. AUTHOR.

3181. Production, Transmission and Reflection of U.V. Radiation. L. R. Koller. *Gen. El. Rev.* 39. *pp.* 232–236, *May*, 1936.—A brief summary is given of the large amount of data on the transmission and reflection of u.v. radiation. The transmission of radiation expressed by Lambert's law, *viz.*, $I/I_0 = e^{-at}$ (% transmission = 100 I/I_0) enables the transmission for any thickness of absorbing material to be calculated, provided a is known. A table is given in which a for the commonly used materials is prepared, reference to a graph in which values of a are plotted as a function of % transmission for various thicknesses of transmitted material enabling speedy calculations to be made. A number of graphs show the transmission through various media as a function of wave-length for several convenient thicknesses of media. The reflecting powers for highly polished surfaces of a number of metals are tabulated. The difficulties of comparing different sources of u.v. radiation are discussed, but tables are given of the total energy radiated in wave-lengths shorter than 3135 Å falling on 1 cm². of surface at a distance of 30 in. from a number of different sources, of the intensities of the principal lines of less than 3135 Å, as well as of the intensities of the radiation in certain broad spectral bands at a distance of 1 m. from the centre of an arc, running under specified conditions. H. J. H. S.

See also Abstracts **3328, 3358.**

RADIATION, GENERAL THEORY.

3182. Mechanical Theory of the Light Corpuscle. S. Serghiesco. *Comptes Rendus,* 202. *pp.* 1563–1565, *May* 11, 1936.—The law of refraction is demonstrated on the basis of the equivalence of mass and energy, and assuming that the light corpuscle is not a projectile but an imponderable material system, the displacement of which is due only to its internal energy and to the energy of the surrounding medium.

N. M. B.

3183. Neutrino Theory of Light. M. Born and N. S. N. Nath. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 318–337, *April,* 1936.—The authors give an exposition of the theory of the neutrino, *ab initio,* in which it is shown how on the assumption of neutrinos satisfying the Fermi-Dirac statistics photons satisfying the Bose-Einstein statistics are derived. The Planck radiation formula is deduced and the energy relations of neutrino and photon are discussed. The authors' views differ from those of Jordan and de Kronig only in that the two kinds of neutrino are regarded as having the same relation as the electron and positron in Dirac's theory of holes, instead of differing in spin. The theory indicates that light radiation should have some influence on β-ray emission of radioactive substances and this might, it is suggested, yield an experimental test of the theory.

W. S. S.

3184. Wave Theory of the Neutrino. G. Rumer. *Comptes Rendus,* 202. *pp.* 1484–1486, *May* 4, 1936.—The mathematical theory of the neutrino, conceived as a spin-tensor of the third rank, is briefly developed.

J. S. G. T.

3185. Selection Rules in Nuclear Radiation. H. M. Taylor. *Cambridge Phil. Soc., Proc.* 32. *pp.* 291–300, *May,* 1936.—On the assumption that the wave-length of the emitted radiation is large compared with the radius of the radiating system, the selection rules for the emission of magnetic dipole and electric dipole and quadripole radiation are derived for the case of a single charged particle moving in a central field and obeying Dirac's equation. The relative intensities of the different types of radiation are also obtained. It is found that for one case, corresponding to a transition between two levels of one multiplet term, magnetic dipole and electric quadripole radiations of comparable intensity are emitted. This provides an explanation of the high values of the experimentally observed internal conversions of soft γ-rays, which probably occur because the γ-rays are largely magnetic dipole in character. The conclusion that soft γ-rays arise from transitions between two levels of a nuclear multiplet agrees with the suggestion of Hulme, Mott, Oppenheimer and Taylor, based on other considerations.

W. S. S.

See also Abstract 3354.

REFLECTION. REFRACTION AND DISPERSION.

3186. Interesting Optical Law. M. Herzberger. *J.O.S.A.* 26. *p.* 205, *May,* 1936.—A demonstration of the fact that for any ray $n \sin\epsilon = n' \sin\epsilon'$ where n and n' are the refractive indices of the object and image space respectively. In the case of a single surface this law is identical with the Snellius-Descartes law of refraction. It is also shown that it holds true for an entire system if it holds true for the component parts.

A. H.

3187. Optics of Nerve Myelin. R. S. Bear and F. O. Schmitt. *J.O.S.A.* 26. *pp.* 206–212, *May,* 1936.—The authors develop the optical theory leading to an expression for the relative retardation of the ordinary and extraordinary rays when light passes transversely through a cylinder comprising a central core of uniaxial material with its optic axis along the cylinder axis, surrounded by a sheath made up of radial uniaxial elements with their axes radially directed. Such a cylinder represents a nerve fibre with myelin sheath. The first-order calculation indicates a maximum retardation for rays passing through the cylinder tangentially to the axis-cylinder-sheath boundary, but experimentally the maximum occurs for rays passing within the sheath. This difference is explained theoretically by allowing for second-order effects and a formula is developed giving the maximum retardation in terms of the difference in refractive index of the ordinary and extraordinary rays in the sheath and the inner and outer sheath radii. For the sciatic nerves of various frogs the difference of refractive index is found to equal 0·011 the nerve diameters ranging from 9 to 17μ. W. S. S.

3188. Refractive Index of Gaseous Heavy Water. C. Cuthbertson and Maude Cuthbertson. *Roy. Soc., Proc.* 155*A*. *pp.* 213–217, *June* 2, 1936.—The refractive index of D_2O in the liquid form has been found by American observers to be less than that of normal water by as much as 0·00456, and the dispersion curve to be flatter. In order to verify whether the same peculiarities exist in the gaseous form the refractive index for $\lambda = 5462 \cdot 23$ and the dispersion ($\lambda\lambda$ 5462–2968) have been measured and compared with those of gaseous normal water. For D_2O, 99·2 % pure, the values found are satisfied by the formula $\mu - 1 = 2 \cdot 6756 \times 10^{27}/(11{,}000 \times 10^{27} - n^2)$, which gives a value, for λ 5462·23, of 0·0002501 against 0·0002527 for normal water, and a flatter dispersion curve. The American observations on liquid D_2O are thus approximately confirmed for the gaseous form. AUTHORS.

3189. Refraction and Dispersion of Deuterium. T. Larsén. *Zeits. f. Physik*, 100. 9–10, *pp.* 543–546, 1936.—The refractive indices and dispersion of D_2 are measured interferometrically between 5790 and 2300 Å. The indices are lower than those of H_2 and the dispersion curve is rather flatter. The change can be explained for the most part by the unequal zero-point energies of the two isotopes. C. B. A.

3190. Maxwell Effect in Liquids. G. G. Paldhikar. *Phil. Mag.* 21. *pp.* 1125–1130, *June*, 1936.—Raman and Krishnan's theory [see Abstract 1878 (1928)] of the Maxwell effect in liquids is applied to the results of Vorländer, Fischer and others and the results for 9 aromatic compounds and 4 aliphatic *n*-hydrocarbons are given. It is shown that the calculated values of the Maxwell constant are of the right magnitude except for nitrobenzene and xylene. Considering the various assumptions involved in the calculation it is claimed that the results are satisfactory. R. L.

3191. Constitution of Glass. W. Büssem and W. Weyl. *Naturwiss.* 24. *pp.* 324–331, *May* 22, 1936.—A review of recent work, with Bibliography, on the physical properties of glasses in relation to their chemical constitution. C. B. A.

***3192. Aberrations of a Microscope Objective. R. Kingslake.** *J.O.S.A.* 26. *pp.* 251–256, *June*, 1936.—A new method is described in which a thin metal plate having a small hole in it is mounted between the objective and the microscope tube in such a way that the hole may be traversed across the middle of the objective aperture by a micrometer screw. The point at which the small beam of light thus isolated intersects the image plane is located by means of a filar micrometer. This gives a direct measure of the transverse aberration of that zone of the lens which contains the sliding hole, from which either the optical path difference or the ordinary longitudinal aberration of the zone can be readily computed.

The aberration is then plotted graphically against the numerical aperture of the zone. The limitations and the precision of the method are discussed. The Foucault knife-edge test is found to be readily adaptable to the measurement of the chromatic aberration of a microscope objective. Typical curves for all these tests are given. **Author.**

See also Abstracts 3066, 3099, 3138, 3141, 3142, 3167, 3181, 3182, 3243, 3322.

SPECTROSCOPY.

3193. Spectrum of Ionised Antimony. S. G. Krishnamurty. *Indian Journ. Phys.* 10. *pp.* 83–90, *March*, 1936.—Sparks in air and H_2 are used as source and a large quartz Littrow spectrograph. Comparison is made with the spectra of Sn I, Te III and I IV, which has led to a modification and extension of the analysis of Sb II due to Lang and Vestine [see Abstract 229 (1933)]. A large number of levels are assigned to proper configurations and a few new terms discovered. **F. S.**

3194. Extreme Ultra-Violet Spectra of Xenon. J. C. Boyce. *Phys. Rev.* 49. *pp.* 730–732, *May* 15, 1936.—Increased dispersion and resolving power have made possible a revision and extension of the work of previous investigators on the spectra of Xe in the extreme ultra-violet. Lists of classified lines are given for Xe I, Xe II and Xe III in the range from λ2000 to λ600. No new lines are found for Xe I but the accuracy of the measurements is considerably improved. Revised identifications are suggested for Xe II in the light of new knowledge of the limits of that spectrum, the low states of Xe III. 128 lines of Xe III are identified in collaboration with C. J. Humphreys, who will publish elsewhere with his analysis of the longer wave-length portion of the spectrum the consolidated term table for this spectrum. **Author.**

3195. New Lines in the Ultra-Violet Spectrum of Atomic Iodine. J. H. McLeod. *Phys. Rev.* 49. *pp.* 804–807, *June* 1, 1936.—A total of 250 lines in the arc and first spark spectrum of atomic iodine are photographed with a vacuum grating spectrograph. A grating of 1 m. radius, ruled with 30,000 lines per in., was used. The region covered extends from 1900 to 800 Å. The spectrum is produced in a mixture of A and I_2. In part of the work, I_2 was prevented from entering the spectrograph by a continual flow of pure A from the spectrograph through the slit to the discharge tube. This permitted the extension of wave-length measurements below the fluorite region to 800 Å. **Author.**

3196. Influence of Temperature on Absorption in Excited Cadmium Vapour Containing Neon. O. Masaki, Y. Morimoto and K. Sakuma. *Hiroshima Journ. Sci.* 6. *pp.* 227–235, *March*, 1936. *In German.*—The influence of temperature on absorption of the lines 5086, 4800 and 4678 Å (CdI. $2^3P_{2,1,0} - 2^3S_1$) in excited Cd vapour with admixture of Ne is investigated. With increasing temperature the absorption of the lines originating from a metastable state sets in at about 160° C. The absorption of λ5086 reaches a maximum at 280° C. and then decreases slightly to a constant value. The absorption of λ4678 shows a small increase between 300° C. and 350° C. and reaches a higher saturation value than λ5086. The line λ4800 begins to show marked absorption from about 260° C. onwards and with increasing temperature reaches the same saturation value as λ5086. The results are similar to observations of the temperature dependence of absorption by excited Hg vapour made by one of the authors [see Abstract 1254 (1931)]. **J. E. K.**

3197. Absorption Spectrum of Rubidium. Ny Tsi-Zé and Weng Wen-Po. *Comptes Rendus*, 202. *pp*. 1428–1430, *April* 27, 1936.—Absorption spectra of alkali metals show, in addition to lines of the series $n\,^2P \leftarrow {}^2S$, certain features described by Kuhn as bands of loosely bound metal molecules and by Datta and Chakravarty as $n\,^2P \leftarrow {}^2S$ lines displaced by an interaction of atoms and molecules. In Rb and Cs other new lines have been observed near the higher $n\,^2P \leftarrow {}^2S$ lines [see Abstract 3052 (1935)]. The new lines observed with dense Rb vapour at 370°, 460° and 550° C. in a steel tube 80 cm. long with quartz windows are tabulated and empirically classified. At 370° the new lines on the short-λ side of the $n\,^2P \leftarrow 5\,^2S$ lines form a series, C, tending to approach them more and more closely, whilst those on the long-λ side form two series, A and B, of which the latter is the nearer to $n\,^2P \leftarrow 5\,^2S$. At 460°, and still more at 550°, some lines of series A, B and C are obscured by the broadening of the $n\,^2P \leftarrow 5\,^2S$ lines, and between the latter appear still more lines forming a series, D, whose higher members occur near the calculated positions of the forbidden lines $n\,^2D \leftarrow 5\,^2S$ and $n\,^2S \leftarrow 5\,^2S$. W. J.

3198. Structure of the D- and F-Terms of Potassium. O. Masaki and K. Kobayakawa. *Hiroshima Journ. Sci.* 6. *pp*. 217–226, *March*, 1936. *In German*.—It has been observed by Meissner and Masaki [see Abstract 3819 (1931)] that the 5^2D and 8^2D and the 6^2F to 10^2F terms of K are all inverted. In order to check this observation measurements are now made of the structure of the composite doublets of the first subsidiary and Bergmann series of K with an interference spectrograph and various étalon separations. The analysis of the lines confirms that the D and F terms are inverted. J. E. K.

3199. Arc and Spark Spectra of Columbium. W. F. Meggers and A. S. King. *Bureau of Standards, J. of Research*, 16. *pp*. 385–419, *May*, 1936.—A new description of conventional arc and spark spectra of columbium (niobium) in the wave-length range 2100 to 12,000 Å is completed. Wave-length measurements are presented for 5700 lines, the majority to 7 significant figures, with an average probable error less than 0·005 Å. Intensity comparisons of lines from the two types of sources permit an unambiguous separation of Cb I, Cb II, and Cb III or Cb IV spectra. These data should facilitate spectroscopic identification and analysis of columbium, and serve as a basis for further study of spectral structures, Zeeman effects, and hyperfine structures. AUTHORS.

3200. Na I-Type Spectra of the Elements Potassium to Copper. B. Edlén. *Zeits. f. Physik*, 100. 9–10. *pp*. 621–635, 1936.—The vacuum spark spectra of the metals Sc(21) to Zn(30) are photographed in the wave-length region 30 to 200 Å with a new concave grating spectrograph with which a resolving power of 0·01 Å is attained. In a preliminary investigation of the spectrograms the most important lines of the Na I-, Mg I- and Al I-like spectra are identified for the whole sequence of elements up to Cu. With the aid of previous measurements by Ekefors [see Abstract 121 (1932)] in the K and Ca spectra a complete analysis of the series of Na I-like spectra is carried out. J. E. K.

3201. Radiation Re-Absorption in the Mercury Discharge. W. Fabrikant and F. Butaewa. *Phys. Zeits. d. Sowjetunion*, 9. 4. *pp*. 383–404, 1936. *In German*.—The hypothesis that the relative intensities of Hg lines with a common upper level can only be influenced by reabsorption is crticially discussed. It is shown that all observed intensity relations can be explained qualitatively on this hypothesis. The lower limits of the reabsorption coefficients of individual lines are determined. It is shown that the results agree qualitatively with the thermic theory of the Hg discharge at high pressures. J. E. K.

3202. Far Ultra-Violet Spectral Intensities and Estimation of Temperature and Pressure in the Vacuum Spark. H. A. Robinson. *Zeits. f. Physik*, 100. 9–10. *pp.* 636–643, 1936.—From observations of Edlén on the appearance of lines in the vacuum spark spectrum corresponding to high degrees of ionisation of elements of the first main period it would normally be concluded that, in regions of longer wave-length, lines belonging to these high degrees of ionisation would appear which are not in fact observed. The absence of these lines is discussed with reference to Einstein's ν^4 correction of the intensity equation and is qualitatively explained. From estimates of the heat in the vacuum spark it is found that temperatures up to 500,000 K° are attained. The Saha-Russell theory of the temperature ionisation of stellar spectra is tentatively applied to the vacuum spark and leads to the conclusion that at the most two ionisation states appear simultaneously and that (electron-) pressures up to about 10^7 atmospheres are reached. The absence of arc lines and lines of the first spark spectrum in the vacuum spark spectrum is qualitatively explained. J. E. K.

3203. Intensities in the Principal Series of Lithium. S. Weintroub. *Phys. Soc., Proc.* 48. *pp.* 535–548, *July* 1, 1936.—The effect of using orthogonal instead of non-orthogonal wave functions in the calculation of the oscillator-strengths (f numbers) of the first three lines of the principal series of Li is investigated. The Hartree self-consistent field method is employed to calculate the ($1s$) radial wave function, and the ($2s$) radial wave function is made orthogonal to the ($1s$) by linear combination. The orthogonal functions are used to calculate the energies of the optical terms ($2s$), ($2p$), ($3p$) and ($4p$), and the f numbers of the first three lines of the principal series. Very satisfactory agreement with observed values is obtained for the energies (the maximum difference being 3 %). The agreement for the f numbers is not so good, but is better than when non-orthogonal functions are used. AUTHOR.

3204. Electric Quadrupole Moment of the $^{209}_{83}$Bi Nucleus. H. Schüler and T. Schmidt. *Zeits. f. Physik*, 99. 11–12, *pp.* 717–728, 1936.—From analysis of the hyperfine structure of several BiI, BiII and BiIII terms the quadrupole moment of the $^{209}_{83}$Bi nucleus is calculated to be $q = -0\cdot4\cdot10^{-24}$, with good agreement between the values provided by the different terms. Intermediate coupling and relativistic corrections are taken into account in the calculations. J. E. K.

3205. Electric Quadrupole Moment and Magnetic Moment of $^{63}_{29}$Cu and $^{65}_{29}$Cu. H. Schüler and T. Schmidt. *Zeits. f. Physik*, 100. 1–2. *pp.* 113–116, 1936.—The electric quadrupole moment of the $^{63}_{29}$Cu and $^{65}_{29}$Cu nuclei is calculated from analysis of the hyperfine structure of the CuI lines λ5700 and λ5782 and from hyperfine structure measurements of other CuI lines by Ritschl [see Abstract 1240 (1932)] to be $q = -0\cdot1\cdot10^{-24}$. The isotope 63 has a magnetic moment $\mu = 2\cdot5$ and for the isotope 65 $\mu = 2\cdot6$. J. E. K.

3206. Hyperfine Structure of Platinum Isotopes. Part II. Barbara Jaeckel. *Zeits. f. Physik*, 100. 7–8. *pp.* 513–528, 1936.—In continuance of a previous investigation of the hyperfine structure of Pt [see Abstract 2205 (1936)] photographs are taken of the hyperfine structures of 46 Pt-I lines and the distances between the components are measured. The author succeeds in arranging the components of Pt^{195} into a term scheme from which are determined the hyperfine structure separations of 27 terms of Pt^{195} and the positions of their centres of intensity. The assumption that Pt^{195} has the mechanical nuclear moment $I = \frac{1}{2}$ is confirmed. It is not found possible to estimate the value of the corresponding nuclear magnetic moment. J. E. K.

3207. Fine Structure of Hydrogen. E. L. Palumbo. *Univ. Nac. La Plata, Publ. No.* 103. *pp.* 89–94, 1935.—The author gives an elementary deduction of Sommerfeld's formula, starting from de Broglie's expression for the wave-length and introducing an auxiliary wave-length $\lambda' = v/\nu = \lambda v^2/c^2$. Circular orbits are then defined by $2\pi a = n\lambda - r\lambda'$, where r is connected with n, k, k'. T. L. M.

3208. Forbidden Lines. I. S. Bowen. *Rev. Modern Physics,* 8. *pp.* 55–81, *April,* 1936.—Surveys the present position regarding forbidden lines. Topics discussed include transition probabilities, quadrupole radiation, intensities of forbidden lines, the physical conditions and mechanism of excitation in the nebulæ. The forbidden lines are then discussed in detail for all systems having from 1 to 18 electrons. A. H.

3209. Spectrum of Cold Flame of Ether. V. Kondratjew. *Acta. Physicochimica,* 4. 4. *pp.* 556–558, 1936. *In English.*—Vaidya [see Abstract 319 (1935)] has attributed the bands of the cold flame of ether to the molecules of HCO. Comparing this spectrum with that given by formaldehyde in absorption and fluorescence it is concluded that H_2CO is the molecule concerned. This is of importance when the mechanism of " cold " oxidations is considered. Since the main product of the " cold " oxidation of ether is formaldehyde it follows that in this reaction molecules of the final products are excited and not those of some intermediate radicals as in most flames. A. H.

3210. Extreme Ultra-Violet Emission Spectrum of Deuterium. C. R. Jeppesen. *Phys. Rev.* 49. *pp.* 797–803, *June* 1, 1936.—The emission spectrum of D_2 is photographed in the extreme u.v. region by use of a grazing incidence vacuum spectrograph with 2-m. grating. In the $2p^1\Sigma - 1s^1\Sigma$ system 37 bands are analysed. In the $2p^1\Pi - 1s^1\Sigma$ system 29 bands are obtained. Constants of the three observed electronic states of D_2 are given and the data are compared with those of H_2. Electronic shifts of 4 cm.$^{-1}$ and 23 cm.$^{-1}$ are observed for the $2p^1\Sigma - 1s^1\Sigma$ and $2p^1\Pi - 1s^1\Sigma$ systems respectively. AUTHOR.

3211. Band Spectra of CaF and CaCl. K. H. Hellwege. *Zeits. f. Physik,* 100. 9–10. *pp.* 644–651, 1936.—The band systems of CaF and CaCl which lie in the visible spectrum are photographed in absorption and arc emission with a 6 m. grating and also in temperature excitation at 1300° C. with smaller dispersion. A particular search is made for an unusual effect of gaseous impurity assumed by Walters and Barratt [see Abstract 1598 (1928)], but this is proved not to occur. A predissociation limit is established in both spectra and some hitherto disputed features of these spectra are clarified. J. E. K.

3212. Absorption Bands of Liquid Oxygen. R. Guillien. *Comptes Rendus,* 202. *pp.* 1373–1375, *April* 20, 1936.—The author has measured the coefficient of extinction (χ) for a number of the absorption bands of liquid oxygen at − 195·6° C., and shows that the shape of the curve χ/χ_{max}, $1/\lambda$ is the same for each band, except that the one at 6290 Å is a little broader than the others. The observed values are compared with results obtained for gaseous oxygen. D. H. F.

3213. λ7635 Band of Liquid Oxygen. R. Guillien. *Comptes Rendus,* 202. *pp.* 1423–1425, *April* 27, 1936.—The molecule $(O_2)_2$ has red and infra-red absorption bands very near those of O_2 in addition to its 13 absorption bands between λ6500 and λ3200. In the gas the easily resolvable 'A' band of the O_2 system $^1\Sigma \leftarrow {}^3\Sigma$ has been observed from the head λ7595 to about λ7703, the origin being near λ7624. In the liquid (1 m. thickness), however, the absorption in this region is continuous and extends farther in each direction, beginning near λ7425, slowly increasing to a maximum near λ7635 and then decreasing to zero near λ7735. When plotted against ν, the ratio χ/χ_m of extinction coefficient to maximum absorption coefficient gives a curve similar to those of the bands $\lambda\lambda$ 5769 and 4773. If the liquid oxygen is diluted with liquid nitrogen (the light always traversing the same mass of oxygen), the curve $\chi/\chi_m : \nu$ for the λ7635 band becomes narrower and the specific extinction coefficient χ_m/ρ (ρ = density) decreases to a limit (not zero), whilst for the bands at $\lambda\lambda < 6500$ the curve remains unchanged and χ_m/ρ tends towards zero; the bands at $\lambda\lambda$ 6895, 8150 and 9190 are narrowed. The u.v. absorption bands observed with compressed oxygen by Herman [see Abstract 5023 (1935)] are probably due to free O_2 and to O_2 in $(O_2)_2$. W. J.

3214. Band Spectrum of Boron Fluoride. H. M. Strong and H. P. Knauss. *Phys. Rev.* 49. *pp.* 740–744, *May* 15, 1936.—The spectrum of BF as excited by the electrodeless discharge is photographed at both high and low dispersion. 16 new bands were observed in the region between 3712 and 2580Å. These bands degrade to the violet, have five head-forming branches, and resemble very closely the third positive bands of CO, a result to be anticipated from the fact that CO and BF both possess ten extranuclear electrons and should therefore have similar electronic configurations. Two systems were found with a common lower electronic level: an A system ($\nu^{(0,0)} = 32{,}020\cdot5$ cm.$^{-1}$) of 12 bands and one isotope band, and a B system ($\nu^{(0,0)} = 37{,}991$ cm.$^{-1}$) of three bands. The constants obtained from the vibrational analysis are: ω_e', 1631·40 cm.$^{-1}$; ω_e'', 1323·64 cm.$^{-1}$; $x_e'\omega_e'$, 23·10 cm.$^{-1}$; $x_e''\omega_e''$, 9·40 cm^{-1}. AUTHORS.

3215. Band Spectrum of Boron Hydride and Boron Deuteride. S. F. Thunberg. *Zeits. f. Physik,* 100. 7–8. *pp.* 471–477, 1936.—The band spectrum of boron deuteride is examined, the molecular constants are determined, and the isotopy law tested. The Λ-separation of the BH and BD bands agrees well with theory. For the $^1\Sigma$ state, the value $\rho^2 = 0\cdot5435$ is found, as compared with $\rho^2 = 0\cdot54237$ calculated from the atomic weights. The possibility of systematising the molecular terms is discussed. C.B.A.

3216. Absorption Spectrum of Aqueous Chlorine and Hydrogen Peroxide Vapour. W. C. Fergusson, L. Slotin and D. W. G. Style. *Faraday Soc., Trans.* 32. *pp.* 956–962, *June,* 1936.—The absorption spectra of aqueous Cl_2 and HClO solutions and of the vapours of HClO and H_2O_2 are investigated. The interpretation of the observations is discussed. AUTHORS.

3217. Absorption of Light by Adsorbed Paranitrophenol. J. F. H. Custers and J. H. de Boer. *Physica,* 3. *pp.* 407–417, *June,* 1936. *In German.*—In the adsorption of *p*-nitrophenol molecules on a BaF_2 surface, two layers are formed. In the first, the OH dipoles are adsorbed electrostatically on the F-ions in the surface, and their absorption spectrum is displaced strongly towards the red from that of free *p*-nitrophenol, the displacement being greater than for adsorption on CaF_2. The molecules in the second layer are attached to those of the first layer by van der Waals forces, their spectrum is also displaced towards the red, and the displacement decreases with increasing thickness of the adsorbed film. C. B. A.

3218. Band Systems and Structure of SiF. R. K. Asundi and R. Samuel. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 346–359, *April*, 1936.—Data obtained by earlier workers on SiF are re-examined in the light of the modern theory of band spectra, with a view to determining the nature of the electronic levels involved. The α, β and γ groups of bands are shown to be due to transitions to the $^2\Pi$ ground level from $^2\Pi$, $^2\Sigma$ and $^2\Sigma$ levels respectively. The δ bands are believed to be part of the γ group. The ϵ bands have not been classified. The constants obtained from the analysis do not differ very much from those obtained earlier. The electronic separation for the lower $^2\Pi$ state is put at 161 cm^{-1}., for the upper $^2\Pi$ state at 29 cm^{-1}. The energies of excitation and dissociation of the observed terms are given and the molecular levels are correlated with those of the separate atoms. A. H.

3219. Ultra-Violet Band-Systems of SiCl. W. Jevons. *Phys. Soc., Proc.* 48. *pp.* 563–573, *July* 1, 1936.—The emission spectrum of SiCl, produced in a tube discharge through a continuous flow of $SiCl_4$ vapour, has three systems of doublet bands degraded towards the further ultra-violet, the 0, 0 bands being λλ 2942, 2924, λλ 2436, 2424, and λλ 2232, 2221. They are attributed to transitions B → X, C → X and D → X, where X is a double level with electronic separation 207·9 cm^{-1}., $\omega_e = 531{\cdot}0$ and $x_e\omega_e = 2{\cdot}2$; B is a single level 34186·0 cm^{-1}. above X with $\omega_{\frac{1}{2}} = 698{\cdot}7$; C is a close doublet 41234·8 and 41247·8 cm^{-1}. above X with $\omega_e = 674{\cdot}2$ and $x_e\omega_e = 2{\cdot}2$; and D is a single level 45005·9 cm^{-1}. above X, with $\omega_{\frac{1}{2}} = 663$. These figures are from band-head measurements only. Datta's analysis of the B → X system is confirmed, except in his identification of the 2, 0 and 3, 0 bands and his interpretation of observed isotope band-heads. With Datta's 2, 0 and 3, 0 bands are two groups of prominent bands between λ 2830 and λ 2770 not fitting into any of the three systems; their emitter may be a chloride of silicon other than SiCl. AUTHOR.

3220. Band Spectra of Hydrides of Lithium. Part III. Potential Curves and Isotope Relations. F. H. Crawford and T. Jorgensen, Jr. *Phys. Rev.* 49. *pp.* 745–752, *May* 15, 1936.—Values of ρ^* derived from band-spectrum constants for LiH and LiD [see Abstract 3503 (1935)] disagree with ρ derived from reduced masses, $(\mu/\mu^i)^{\frac{1}{2}}$. The discrepancy $\rho^*-\rho$ is positive for eleven constants in the ground state, $x^1\Sigma$, and negative for ten in the excited state $A^1\Sigma$. For the ground state the effect of anharmonicity (calculated from the anharmonicity coefficients obtained by use of Dunham's equations) on the isotope ratio slightly reduces $\rho^*-\rho$ in two cases out of five. For the upper state the anharmonicity constants are derived by a laborious approximation process, and the resulting values account satisfactorily for both signs and values of the nine constants previously reported as abnormal; the abnormality is therefore not due to *L*-uncoupling; Dunham's corrections further reduce $\rho^*-\rho$ by about 25 % in four cases out of five. The dissociation energies D_0 for the ground and excited $^1\Sigma$ states are 2·54 and 1·18 V. respectively for LiH, and 2·53 and 1·15 V. respectively for LiD (all ± 0·2 V.). W. J.

3221. $c^2\Sigma \rightleftharpoons x^2\Sigma$ Band System of BaH. G. W. Funke and B. Grundström. *Zeits. f. Physik*, 100. 5–6. *pp.* 293–306, 1936.—The rotational analysis of the λλ 4014 (1, 0) and 4000 (2, 1) bands of this system in absorption [see Abstract 2732 (1936)] is now supplemented by that of the λλ 4228 (0, 0) and 4201 (1, 1) bands. For the $c^2\Sigma$ state, $B_0 = 3 \cdot 53$ and $D_0 = 10^{-5}$. Wave-numbers are tabulated for the lines of all four bands in absorption and of the 1, 1 band in emission. Wave-numbers of new lines of the corresponding 0, 0 band of CaD [see Abstract 5034 (1935)] are also tabulated. The perturbations of the rotational levels of $c^2\Sigma$ $(v = 1)$, as revealed in the 1, 1 band of BaH, resemble those of CaD, $c^2\Sigma$ $(v = 0)$ with which they are compared graphically; they consist of large shifts, doublings (maximum about 40 cm^{-1}.) and intensity changes. The predissociation of the $c^2\Sigma$ state is studied in detail. It represents a limiting case, in which the radiationless dissociation is so slight that the affected lines are not much broadened in absorption and are detectable in emission with very long photographic exposures. Since the ^1D and ^3D states of Ba are deeper than the ^3P state the predissociation processes are more complicated in BaH than in CaH and SrH. W. J.

3222. $A^1\Pi \rightarrow X^1\Sigma$ (IV Pos.) Bands of Carbon Monoxide. Part II. L. Gerö. *Zeits. f. Physik*, 100. 5–6. *pp.* 374–388, 1936.—The rotational analysis of the IV positive CO bands [see Abstract 1663 (1936)] is extended. Measurements are reported for the bands (9, 18), (11, 20), (12, 22) and (13, 24) and for a zero-line system of 84 bands, whence the vibrational terms of the $X^1\Sigma$ and $A^1\Pi$ states are calculated. The position of predissociation of the $A^1\Pi$ state is found to lie 77,497 ± 44 cm^{-1}. above the $X^1\Sigma$ ground-state. Another predissociation is surmised at 81,880 cm^{-1}. The energy of dissociation of the CO molecule comes out to be 55,820 cm^{-1}. or 6·89 V. L. A. W.

3223. Band Spectrum of Sulphur. E. Olsson. *Zeits. f. Physik*, 100. 9–10. *pp.* 656–664, 1936.—The absorption spectrum of S is photographed in the third order of a large grating with a dispersion of 0·6 Å/mm. The bands (3′–2″), (2′–2″), (3′–3″), (2′–3″), (1′–3″), (2′–4″) and (1′–4″) which lie in the region 3170 to 3430 Å are analysed and each is found to consist of three R and three P branches. Although the triplet separation deviates considerably from that observed in O_2 and SO bands it is concluded that the band type is the same in the three cases, namely, $^3\Sigma^-_u$–$^3\Sigma^-_g$. Each second (even) rotation level is missing from the ground state thus proving that the nuclear spin of S^{32} is zero. The heat of dissociation of the ground state is probably not greater than 3·6 eV. J. E. K.

3224. Rotational Constants of SnS. E. N. Shawhan. *Phys. Rev.* 49. *pp.* 810–812, *June* 1, 1936.—Rotational constants of SnS in its lowest state and one excited state are determined from the (0,0) and (1,0) bands of the visible system. Empirical formulæ are used to determine the combination differences. The constants determined at $B' = 0 \cdot 140$ cm^{-1}. and $r_e' = 2 \cdot 18$Å for the upper state of the visible system and $B'' = 0 \cdot 157$ cm^{-1}. and $r_e'' = 2 \cdot 01$Å for the lowest state of the molecule. AUTHOR.

3225. Isotope Corrections in Molecular Spectra. J. H. van Vleck. *J. Chem. Phys.* 4. *pp.* 327–338, *June*, 1936.—According to the simple theory of the rigid rotator and harmonic oscillator the coefficients of $J(J+1)$ and $(v + \frac{1}{2})$ in the energy should be inversely proportional respectively to the reduced mass and its square root. Various small corrections, important only in compounds containing hydrogen or deuterium, make the mass dependence slightly different, explaining why spectroscopic observations may yield slightly incorrect mass ratios for isotopes. Corrections are due to (*a*) anharmonicity, (*b*) interaction between vibration and electronic motion, (*v*) L uncoupling, (*c*) interaction between states of equal Λ. The relative magnitudes of the different effects are estimated, and perturbations between states of equal Λ are studied. They should increase in intensity with *v*, in contrast to perturbations due to L uncoupling, which increase with J. The electronic isotope shift, or displacement in the absolute value of the energy is also treated. Here the correction for motion of the centre of gravity of the molecule, usually neglected, is shown to be quite important. Shifts for ultra-violet lines of hydrogen are calculated with Wang wave functions and agree qualitatively with experiment. A. H.

3226. Absorption Spectra and Photodissociation of Some Inorganic Molecules. M. Jan-Khan and R. Samuel. *Phys. Soc., Proc.* 48. *pp.* 626–641, *July* 1, 1936.—The absorption spectra of PCl_3, PBr_3, PCl_5, PBr_5, $POCl_3$, P_2O_5, $AsCl_3$, $SbCl_3$, SbOCl, and $BiCl_3$, are investigated. The regions of selective absorption are correlated to certain photodissociation processes. A comparison with the mean bond energies as known from thermochemical measurements, allows certain conclusions to be drawn as to the structure of these molecules. AUTHORS.

3227. Fluorescence of Terbium Salts in Solution. A. Filippov, J. Larionov and A. Seidel. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 1. 6. *pp.* 253–256, 1936. *In English.*—A variety of aqueous solutions (containing Tb, Er, Gd and Dy) are found to exhibit a yellow-green fluorescence when exposed to the illumination emitted by Ni or Cd sparks. The effect is due almost entirely to radiations between 2300 and 2500Å. The fluorescence spectrum consists of four narrow bands (blue, green, orange and red) and the distribution and appearance of the bands is the same for all the preparations for which this fluorescence is detected. The spectrum is attributed to the presence of the terbium ion. A. H.

3228. Zeeman and Paschen-Back Effects in Neon Spectrum. P. Jacquinot. *Comptes Rendus,* 202. *pp.* 1578–1580, *May* 11, 1936.—The displacements in the Paschen-Back effect can be written in the form $\Delta\nu_m = mg\omega + \beta_m\omega^2$, ω being the field and m the magnetic quantum, and the constants β_m can be derived from Houston's equation [see Abstract 2483 (1929)]. The $2p^5ns$ series of Ne exhibits the transition from Russell-Saunders to extreme *j-j* coupling and the results of measurements for these lines are shown to be in satisfactory agreement with theory. C. B. A.

3229. Effect of Electric Field on Absorption Spectrum of Na. Ny Tsi-Zé and Weng Wen-Po. *J. de Physique et le Radium,* 7. *pp.* 193–197, *May,* 1936.—In the absorption spectrum of Na vapour in electric fields of 0–2800V/cm. the number of detectable lines of the $n^2P \leftarrow 3^2S$ series diminishes as the field is increased, and between these lines, in both σ and ω components, new lines are developed, which apparently belong to forbidden transitions $n^2D \leftarrow 3^2S$ and $n^2S \leftarrow 3^2S$. For the higher members of the $n^2P \leftarrow 3^2S$ series a quadratic Stark effect is observed on the short-λ side, which is greater in ω than in σ. The $n^2D \leftarrow 3^2S$ lines are split into equidistant Stark components which increase in both number and interval with n; their intervals are proportional to the field. In the $n^2S \leftarrow 3^2S$ series the first observable members are slightly displaced in the long-λ direction by an amount proportional to the square of the field, whilst the higher members show a typical linear Stark effect on the short-λ side; on account of the superposition of the quadratic and linear Stark effects, the intermediate members of this series are displaced in one direction or the other according to the value of *n* and the field intensity. W. J.

3230. Raman Spectrum and Electrolytic Dissociation of Selenic Acid. C. S. Venkateswaran. *Indian Acad. Sci., Proc.* 3*A*. *pp*. 307–317, *April*, 1936.—The Raman spectra of crystalline solid, molten, and supercooled liquid selenic acid (H_2SeO_4) and of aqueous solutions of the acid of concentrations varying from 7·5 to 92·5 % were photographed and the frequency shifts, approximate intensities and structure of the Raman lines recorded. The variation of the Raman spectrum with concentration of the solution closely resembles that observed for sulphuric acid and is similarly interpreted as corresponding to ionisation in two stages: $H_2SeO_4 \rightarrow HSeO_4 + H \rightarrow SeO_4 + 2H$. The first stage starts from the solid and the second stage from about 50 % concentration. The modification in the Raman spectrum in passing from the solid to the liquid is of a kind characteristic of the heteropolar nature of the chemical bond in the acid molecules. W. S. S.

3231. Raman Spectra of Substituted Cyclohexenes. E. Canals, M. Mousseron, L. Souche and P. Peyrot. *Comptes Rendus*, 202. *pp*. 1519–1521, *May* 4, 1936.—Continuing previous work [see Abstract 677 (1934)] Raman frequencies are observed and tabulated for mono-substituted derivatives of cyclohexene containing the substituents methyl, ethyl, propyl, iso-propyl, butyl, phenyl, benzyl and cyclohexyl. L. A. W.

3232. Raman Spectra of 2-Methybutene-1 and 2-Methylbutene-2. Dorothy D. Thompson and Mary L. Sherrill. *Am. Chem. Soc., J.* 58. *pp*. 745–747, *May*, 1936.—The Raman spectra of the low and the high fractions of the hydrocarbon obtained by the dehydration of tertiary amyl alcohol show the former to be a mixture of 2-methylbutene-1 and 2-methylbutene-2, while the latter is practically pure 2-methylbutene-2. AUTHORS.

3233. Raman Spectrum of Cyclopropane and Polymerisation by Ultra-Violet Light. L. Harris, A. A. Ashdown and R. T. Armstrong. *Am. Chem. Soc., J.* 58. *pp*. 852–853, *May*, 1936.—The high transmission of cyclopropane to the ultra-violet has made possible the use of the intense 2536 Å line of Hg for excitation of the Raman spectrum. The Raman spectrum of cyclopropane consists of fourteen frequencies. Only one strong line was observed in the Raman spectrum of gaseous cyclopropane. It had the same frequency shift as the strongest line in the liquid. A mercury-sensitised photochemical polymerisation of cyclopropane has been observed under the influence of the 2536 Å radiation of Hg. The resulting product is a colourless oil of high boiling point. AUTHORS.

3234. Raman Spectrum of CD_2Br_2. B. Trumpy. *Zeits. f. Physik*, 100. 3–4. *pp*. 250–252, 1936.—The Raman frequencies of CD_2Br_2 are measured, and the frequency shifts due to the substitution of the CH_2 group by CD_2 are briefly discussed. D. H. F.

3235. Raman Effect and Dipole Moment in Relation to Free Rotation. Part III. Raman Spectra of Solid Ethylene Halides. S. Mizushima, Y. Morino and S. Noziri. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 630. *pp*. 63–70, *May*, 1936. *In English*.—Although the molecule $XH_2C–CH_2X$ has the axis of intramolecular rotation, it takes practically the *trans* form in the solid state. The calculated chain frequencies symmetric to the centre are in good agreement with those of the observed Raman lines. In solutions, however, the deviation of the mean rotational state from the *trans* position takes place to various degrees with the change of solvent. [For Part II see Abstract 1810 (1935).] AUTHORS.

***3236. Improvement of Speculum Gratings by the Application of Aluminium. A. B. Focke.** *J.O.S.A.* 26. *pp.* 235–237, *June*, 1936.—Tests made on a clean concave speculum metal grating show that if the surface is coated with Al by evaporation, the time required to obtain a photograph of a spectrum is reduced by a factor which is the ratio of the reflection coefficient of Al to that of the speculum metal. The speed of the original grating was increased for the given wave-lengths by the following amounts: 4077Å–45 %, 3341Å–80 %, and 2536Å–170 %. In preliminary tests the observed increase in speed was very much greater than indicated by these values, since the initial tests were made before the grating had been sufficiently cleaned. AUTHOR.

***3237. Quantitative Spectrum Analysis. O. Fagioli.** *N. Cimento*, 13. *pp.* 111–130, *March*, 1936.—After a detailed description of the spectrophotometer depending on the use of a sector disc with logarithmically-contoured opening, the author discusses the difficulties involved in making accurate estimates of the lengths of the various lines on the spectrogram. He describes a piece of optical apparatus which enables the vanishing ends of two lines to be compared under favourable conditions so that it is possible to obtain very accurately the difference between the lengths of two lines. In a second part of the paper he describes a method for controlling the conditions under which the spectrum is emitted, so that the spectrograms obtained for any set of alloys, for instance, may be strictly comparable. The control involves the measurement of both the instantaneous maximum of current in the spark as well as the effective current. J. W. T. W.

3238. Quantitative Spectrum Analysis of Small Traces. W. Seith and A. Keil. *Zeits. f. Elektrochem.* 42. *pp.* 299–302, *June*, 1936. —Experiments on the spectrum analysis of various alloys are described. Under suitable conditions, AuAg and AgSn can be analysed quantitatively by this method. C. B. A.

See also Abstracts **2929, 2943, 3021, 3023, 3118, 3139, 3266, 3358.**

VISION.

3239. Scotoscopic Effect in Vision. F. Allen and M. J. Oretzki. *Canad. J. of Research*, 14. *Sect. A. pp.* 71–86, *April*, 1936.—When an illuminated wall of a room is observed by the two eyes, before one of which a tube with opaque sides is held, the patch of the wall seen through the tube appears brighter and nearer to the eye than the rest of the surface appears to the other eye. This may be termed the photoscopic effect. If the side of the tube is translucent and brightly illuminated, the patch of the wall will appear darker than the remainder of the surface. When a sectored disc is rotated at a certain critical speed in front of the tube, the patch of the wall seen through it appears intensely black. This appearance of blackness is called the scotoscopic effect. The critical speed of rotation of the disc at which the scotoscopic effect appears, differs for the fovea, macula and periphery of the retina. The respective areas of those regions are quite sharply distinguished from one another. AUTHORS.

3240. Photography of the Human Eye. E. F. Fincham. *Phot. J.* 76. *pp.* 268–274, *May*, 1936.—The author describes the methods used and the difficulties encountered in photographing the various parts of the human living eye for scientific purposes. Photomicrography of sections of the human retina is also dealt with. The paper includes a number of outstanding photographs obtained by the author. W. S. S.

See also Abstract 3162.

X-RAYS.

3241. Total Reflection of X-Rays. P. P. Ewald and E. Schmid. *Zeits. f. Krist.* 94. *pp.* 150–196, *June*, 1936.—The optical total reflection and interference total reflection of X-rays are defined and their relationship qualitatively explained on general grounds. The Fresnel solution of the problem of the reflection of light (or X-rays) at a single surface is reconsidered and is used in the solution of the problem of a crystal plate (with two boundary faces). A very full mathematical treatment of the latter problem is given. J. T.

3242. L-Spectra of Iron, Cobalt, Nickel and Copper. F. C. Chalklin. *Roy. Soc., Proc.* 155*A*. *pp.* 366–385, *June* 2, 1936.—L-spectra of Fe, Co, Ni and Cu are studied with a plane grating vacuum spectrograph [see Abstract 4558 (1933)]. Examination of the ferromagnetic elements at high and normal temperatures shows that, to about 1 V, the energy levels are independent of their magnetic state. The wave-length measurements are compared with those of other workers and it is pointed out that the differences between the results of various researches are probably due to the asymmetrical structure of the lines. The Lα lines are found to possess abnormal spread on the long wave side, the width from the maximum of the line to the end of the " tail " varying from 48 eV for Fe to 79 eV for Ni. The origin of the large width is discussed. C. J. B.C.

HEAT.

CALORIMETRY.

3243. Specific Heats and Related Properties of the Binary System Methyl Alcohol-Toluene. L. S. Mason and E. R. Washburn. *J. Phys. Chem.* 40. *pp.* 481–491, *April*, 1936.—An efficient adiabatic technique for measuring specific heats of solutions of organic liquids is developed; it is readily adapted for the determination of heat changes attending the solution of liquids in each other. The specific heats and heats of mixing of methyl-alcohol-toluene solutions are determined at 25° C. and 35° C. for the entire concentration range. The observed heat capacities are always greater than those calculated from an additive law. Mixing of the liquids is accompanied by absorption of heat in all cases. The refractive indices of the solutions, and the changes of volume (contractions) on mixing are measured. The refractive indices are lower than those computed on the basis of additivity. The thermal effects are accounted for by assuming that methyl alcohol, which is associated in the pure state, undergoes dissociation into simpler molecular aggregates during mixing. A union of constituent molecules is assumed to explain changes of volume and refractive index. C. J. B. C.

3244. Thermal Constants of Hydrogen Sulphide. W. F. Giauque and R. W. Blue. *Am. Chem. Soc., J.* 58. *pp.* 831–837, *May*, 1936.—The heat capacities of solid and liquid H_2S are measured, over their respective ranges, from 16° K. to the boiling point, by the method previously described [see Abstract 3550 (1935)]. The heats of transition, fusion and vaporisation are also determined. A transition is found at 103·52° K. and a region of large energy absorption, possibly ending in a transition, near 126° K. The melting and boiling points are 187·61 and 212·77° K. The vapour pressure of solid and liquid are measured and the results represented by two equations. The molal entropy of the gas at the boiling point is computed as $46 \cdot 38 \pm 0 \cdot 1$ e.u. compared with the spectroscopic value 46·441 calculated by Cross. C. J. B. C.

See also Abstracts 2987, 3308.

CONDUCTION.

3245. Thermal Conductivity of Air and Other Technically Important Gases. J. Ulsamer. *V.D.I.* 80. *pp.* 537–543, *May* 2, 1936. —A detailed account is given of the possible sources of error involved in the determination of the thermal conductivity of a gas by either the hot wire method or the plate method. Earlier experimental results are discussed in the light of the recent measurements of Kannuluik and Martin [see Abstract 2550 (1934)] and Hercus and Sutherland [see Abstract 3336 (1934)]. The former workers used a hot-wire method, the latter a plate method, and the two results for air agreed to within 1 %. Recent data for a number of gases are tabulated. The most probable values of the thermal conductivity at 0° C. of air, H_2, O_2, N_2 and CO_2 are $5 \cdot 74 \times 10^{-5}$, $41 \cdot 4 \times 10^{-5}$, $5 \cdot 83 \times 10^{-5}$, $5 \cdot 73 \times 10^{-5}$ and $3 \cdot 44 \times 10^{-5}$ C.G.S. units respectively. R. W. P.

3246. Thermal Conductivity of Glycerin-Water Mixtures. S. Erk and A. Keller. *Phys. Zeits.* 37. *pp.* 353–358, *May* 15, 1936.—The thermal conductivity of aqueous glycerin solutions is measured at temperatures between 6° C. and 72° C., and for glycerin concentrations of 18 to 88 % by weight. The apparatus and method used is a modification of that described by Jakob [see Abstract 477 (1921)] and the estimated accuracy of the determination is ± 2 %. Within the range of these experiments the thermal conductivity is given by the equation $\lambda = 0{\cdot}5513\,(1-0{\cdot}5831\,c)\,(1 + a(t-50))$. Tables giving the values of a, for different glycerin concentrations c, and values of the conductivity derived from this equation at various temperatures and concentrations are included. The results are compared with earlier data for the two liquids. R. W. P.

DILATATION.

***3247. Electrical Dilatometer for Use at High Pressures. E. Cohen and A. K. W. A. van Lieshout.** *K. Akad. Amsterdam, Proc.* 39. 5. *pp.* 596–603, 1936. *In German.*—A dilatometer is described and illustrated, in which changes in volume can be observed in terms of the change in resistance of a Pt wire partially immersed in a Hg column responding to the volume changes. Two pressure vessels of differing capacities are constructed in which this device is incorporated, and these are used to study the transformation of grey to white tin at a constant temperature of 13·2° C. under the influence of various pressures up to 200 atmospheres. R. W. P.

See also Abstract **2996.**

MELTING AND BOILING POINTS.

3248. Freezing and Boiling Points of Propane. Mildred M. Hicks-Bruun and J. H. Bruun. *Am. Chem. Soc., J.* 58. *pp.* 810–812, *May,* 1936.—A sample of pure propane has been prepared by treatment of high grade commercial propane with chlorosulphonic acid and by subsequent fractional distillation at atmospheric pressure. The experimental value found for the freezing point of propane was $-187{\cdot}1 \pm 0{\cdot}1°$, which indicates that although the generally accepted value for this constant is nearly three degrees too low, the present value is also lower than that of methane. AUTHORS.

3249. Freezing Points of Aqueous Dioxane-Alkali Chloride Mixtures. G. Scatchard and Marjorie A. Benedict. *Am. Chem. Soc., J.* 58. *pp.* 837–842, *May,* 1936.—The freezing points of aqueous solutions of dioxane are measured up to a concentration of 2 *M*. The osmotic coefficient is found to increase slightly and almost linearly with increasing concentration. The freezing points of aqueous solutions of two mixtures each of potassium, sodium and lithium chlorides with dioxane are measured up to a total concentration of dioxane plus ions of 2 *M*. The results are expressed analytically as functions of the concentrations. At low concentrations the osmotic coefficients of the mixtures are smaller than the Debye-McAulay theory demands, but agree well with the second theory of Debye. The salting out effects of molal salt solutions calculated from these measurements have nearly the same relative values as those directly measured for diethyl ether. AUTHORS.

3250. Melting-Point Curves of Optical Isomerides. J. D. M. Ross. *Chem. Soc., J. pp.* 718–723, *May,* 1936.—The melting point curves for the systems consisting of the *d* and *l* isomers of $\gamma\gamma\gamma$-trichloro-β-hydroxybutyric acid (I), its methyl ester (II), and of methyl (III) and ethyl (IV) mandelates indicate in all cases formation of a racemic compound. Analyses of the curves near the melting points of such compounds indicate their approximate degree of dissociation to be (I) 10 %, (II) 16 %, (III) 20 %, and (IV) 20 % respectively. The dissociation constant of (I) is 10^{-4}. C. A. S.

3251. Distillation Range and Penetration of Creosote into Paper Strips. C. J. Frosch. *Physics*, 7. *pp.* 167–178, *May*, 1936.—Measurements of the penetration tensions (surface tension × contact angle) in paper of a series of creosotes distilled from a single coal tar are reported. These data conform to two equations: one, previously developed by others from theoretical considerations of the effects of variation in size and distribution of capillary pores upon the theoretical equation of flow, the other, an empirical relationship which is less difficult to apply in more practical problems where many data must be analysed. The creosote-paper contact angles are shown to be zero or extremely small. Possible errors in the paper strip method are discussed and the importance of calibrating each strip with a reference liquid is demonstrated. The failure of Washburn's equation, which has received considerable attention in the field of fibrous penetration, is shown to be due to the neglect of the hydrostatic head term. The penetration tensions of these creosotes are unaltered by the presence of adsorbed water. [See Abstract 2632 (1935).] AUTHOR.

***3252. Study of Evaporation Processes by Means of Kinematographic Records of Vapour Bubbles. W. Fritz and W. Ende.** *Phys. Zeits.* 37. *pp.* 391–401, *June* 1, 1936.—In connection with an earlier work [see Abstract 3330 (1935)] the formation of vapour bubbles on a plane horizontal heated surface is investigated photographically. These records show that the volume of a bubble of vapour as it leaves the surface is that which theory indicates to be the maximum volume. By means of a kinematograph taking 600 pictures a second records are obtained from which the rate of growth of the bubbles, their number, and velocities within the water can be evaluated. From a knowledge of the heat conducted into a bubble limiting values for its rate of growth can be calculated. The measured values lie practically within these limits. The investigation lends support to the idea, that, to promote evaporation, heat energy first passes from the hot surface to the water and then from the water to the surface of the vapour bubble. The mean value for the heat transfer coefficient for evaporation at this surface is 16,000 k.cal./m^{2}h°C. R. W. P.

***3253. Small Multiple Still. F. R. Pratt.** *Rev. Sci. Instruments*, 7. *pp.* 211–213, *May*, 1936.—When a simple still produces 1 gall. of distilled water, about 10 gall. of hot water are wasted. This waste of heat and water are important when large quantities of water are required. A commercial multiple still is economical but needs a skilled operator. The operating temperatures and pressures of a multiple still are studied, and utilising the information obtained an easily operated six-unit multiple still is designed. The still is electrically heated. It is estimated that the cost of producing 1 gall. of distilled water with this apparatus is about one-quarter the cost of producing the same quantity with a simple still. C. J. B. C.

See also Abstracts 2944, 3244, 3254, 3256, 3272.

TEMPERATURE, MEASUREMENT OF.

***3254. Helium Liquefying Apparatus, and Production of Temperatures below 1° (Abs.) and Ferromagnetism in Paramagnetic Salts at Very Low Temperatures. N. Kürti, P. Lainé, B. V. Rollin and F. Simon.** *Comptes Rendus*, 202. *pp.* 1421–1423, *April* 27, *and pp.* 1576–1578, *May* 11, 1936.—An arrangement is described for obtaining and preserving for 4–5 hr. He at 1° Abs. and by this means and the Bellevue magnet to obtain temperatures below 0·009° Abs., at which temperature several paramagnetic salts exhibit ferromagnetism. Thus with a cylinder of ferric alum 13 × 102 mm., a field of 32 kilogauss, and an initial temperature of 1·08°, a temperature below 0·009° was obtained, at which the ferric alum showed marked remanence amounting with an inducing field of 1·4 gauss to $0\cdot4_8$ c.g.s. On raising the temperature to 0·009 this fell to half and vanished at 0·01°. Saturation was reached with 7 gauss. Chrome alum appeared to behave similarly. [See Abstract 2293 (1936).] C. A. S.

3255. Thermodynamical Temperature Scale Below 1° K. W. J. de Haas and E. C. Wiersma. *K. Onnes Lab. Leiden, Comm. No.* 241*c*. *Physica*, 3. *pp.* 491–494, *June*, 1936. *In English.*—Measurements on $Cs_2SO_4\cdot Ti_2(SO_4)_3\cdot 24\,H_2O$ show that σ remains constant when demagnetised from 24075 at 1·20° K. down to 104·6 gauss. It is shown from this result that it is possible for such salts to determine the thermodynamic scale of temperatures for a large interval below 1° K. by means of magnetic measurements only. [See Abstract 3181 (1935).] AUTHORS.

3256. Freezing Point of Palladium. F. H. Schofield. *Roy. Soc., Proc.* 155*A*. *pp.* 301–308, *June* 2, 1936.—The freezing point of Pd on the International Temperature Scale has been determined by measuring the ratio of brightness, for a certain wave-length, of black-body radiators held at the freezing points of Pd and Au, the latter being the basic point of the scale for all high temperatures. The experimental procedure was similar to that adopted at the Laboratory and elsewhere for determining the freezing point of Pt and the value obtained, 1554·4 ± 1° C, confirms that of 1555° C recommended in the specification for the International Temperature Scale. AUTHOR.

***3257. Thermometric Liquids. W. Grundmann.** *Zeits. f. Instrumentenk.* 56. *pp.* 248–250, *June*, 1936.—Siebert and Kuhn challenge the remarks of the author [see Abstract 2100 (1934)] regarding the disadvantages of coloured liquids in thermometers. The author discusses the following objections to the use of liquids other than mercury: (1) The inertia of the liquid to differences in temperature, *i.e.*, the lack of sensitivity. (2) Errors in indication due to absorption of heat radiation. (3) The alteration of the viscosity of the liquid due to colouring matter. (4) The bleaching of the coloured solution. (5) The alteration of the readings due to deposited colouring matter. (6) The adhesion of the coloured liquid to the glass walls of the capillary. He shows that these are minimised or absent in mercury thermometers and again reiterates his statements in the previous paper. S. G. B.

***3258. Comparison of Platinum-Resistance and Helium Thermometers from − 190° C. to − 258° C. W. H. Keesom and A. Bijl.** *K. Onnes Lab. Leiden, Comm. No.* 242*b*., *Physica*, 3. *pp.* 418–424, *June*, 1936. *In English.*—The resistance curves of four Pt resistance thermometers are determined between − 190° C. and − 258° C. The curves show considerable differences. The formula of Henning and Otto is applicable to three of the thermometers. AUTHORS.

***3259. Temperature of the Iron Thermit Reaction. H. v. Wartenberg and G. Wehner.** *Zeits. f. Elektrochem.* 42. *pp.* 293–298, *June,* 1936.—The mechanism of the iron thermit reaction is studied practically and full details of the optical, spectro-analytical and pyrometric methods are described. The theoretically possible temperature, as indicated by calculations of the heat balance, is not reached, *viz.*, 3200° C. The spectrum and the optical pyrometer measurements are compared with similar procedure for a black body at known temperatures which are photographically recorded. The photographic measurement of the spectra indicates that the thermit radiation is grey, and has a black-body temperature of between 2250° and 2300° C. The possibility of the existence of Fe_3O_4 and FeO up to very high temperatures is investigated. Taking into account the possible influence of Fe_3O_4 from its known absorption, a temperature of 2400° ± 50° C. is indicated. S. G. B.

THERMOCHEMISTRY.

3260. Heat of Formation and Free Energy of Formation of Boron Nitride. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 629, *pp.* 53–62, *May,* 1936. *In English.*—The heat of formation and the free energy of formation of BN at 25° C. are computed from its dissociation pressure and the specific heats of B, BN and N_2. The results obtained are as follows: $2BN = 2B + N_2 - 56{,}940$; $\Delta F_{298} = 54{,}760$ cal. AUTHOR.

3261. Development of Explosions. W. Finkelnburg. *Zeits. f. ges. Schiess-und Sprengstoffwesen,* 31. 4. *pp.* 1–6, 1936. *Suppt. Ann. d. Physik,* 26. 2. *pp.* 116–120, *May,* 1936.—A discussion of the theoretical and technical factors concerned in the development of an explosion. The present theory is supported by the experimental results of Muraour and Michel-Lévy. The collision of gas molecules causes a part of the energy of impulse to be changed to kinetic energy and in consequence the electron distribution is influenced and less energy is left. The propagation of impulse waves through a gas causes the illumination to be less intense than passage of a similar wave through a solid body. The collision of two impulse waves in opposite directions of propagation creates a double energy at the point of contact. The illumination becomes particularly intense at this point, and extends further into the ultra-violet. The intensity of illumination at the point of superposition or meeting will be greater the larger the colliding particles and the number of electrons contained by them. The influence of polyatomic molecules, etc., is discussed. The paper indicates the possibility of a kinetic-gas explanation of explosion phenomena. S. G. B.

3262. Flame of CO and O_2. H. Kondratjewa and V. Kondratjew. *Acta. Physicochima,* 4. 4. *pp.* 547–555, 1936. *In English*—The effect of pressure (10 to 150 mm.) on the intensity of the visible radiation emitted by the flame of a $CO + O_2$ mixture is investigated. The ratio of the light intensity to the rate of CO_2 formation increases with pressure up to a maximum at 35–37 mm. The decrease in the relative intensity from the maximum to its value at 150 mm. follows a hyperbolic law indicating that the decrease is due to quenching of the chemiluminescence. The quenching efficiency is of the order of unity. It is suggested that there are two mechanisms for the oxidation of CO and that about one out of every ten CO_2 molecules formed in the flame is excited. Such a high proportion of excited CO_2 molecules indicates that they must play an important part in the kinetics of oxidation of CO. A. H.

See also Abstracts 3153, 3226, 3243, 3259.

THERMODYNAMICS.

3263. Thermal Data and Fusion Curves of Helium. J. J. van Laar. *K. Akad. Amsterdam, Proc.* 39. 5. *pp.* 612–622, 1936. *In German.*—The author briefly points out that certain data with respect to the latent heats of fusion of He I and II are either inexact or unknown, and then indicates how from the available data of fusion pressure as a function of temperature a whole series of calorimetric quantities may be obtained fairly accurately. The author first determines accurately the position of the λ-triple point, where the two fusion curves and the transformation (λ) curve meet ($T = 1{\cdot}774$ K°; $p^{atm} \doteq 28{\cdot}91$), and then investigates each of the three curves separately. H. H. Ho.

3264. Thermodynamic Properties of Nitric Oxide. O. K. Rice. *J. Chem. Phys.* 4. *pp.* 367–372, *June*, 1936.—Liquid NO consists largely of double molecules, as evidenced by the abnormally high entropy of vaporisation and the high and variable specific heat. By making use of these data it is possible to calculate the extent to which single molecules exist in the liquid, the heat of dissociation of the double molecules, and the value the specific heat would have were the association in the liquid complete. A statistical calculation is made of the entropy of vaporisation, and the result compared with the experimental value. An estimate is made of the heat of dissociation in the gas phase. AUTHOR.

3265. Quantum Theory of Phase Equilibrium in Alloys. S. T. Konobejewski. *Ann. d. Physik,* 26. 2. *pp.* 97–115, *May*, 1936.—The present investigation of the structure and stability region of phases of the Hume-Rothery type leads to the conclusion that it is more correct to regard these phases not as chemical compounds with definite chemical formulæ, but as true intermetallic phases of variable composition whose stability is conditioned by the property of the electronic gas of given concentration of possessing a minimum energy for a definite lattice structure. The conditions of heterogeneous equilibrium of two solid solutions have been determined. The free energy of the solid solution is established: (1) by the change of entropy during increase of concentration of the solid solution; (2) by the increase of energy in consequence of the non-uniform tensions in the lattice; (3) by the fluctuations of kinetic energy of the valency electrons in the vicinity of critical value of the concentration in consequence of the quantum conditions (Fermi Statistics) of the electrons in the lattice. The application of the theory of Bloch-Brillouin to the electrons of the lattice of the solid solution has enabled the calculation of a special minimum on the curve of total energy (with respect to the thermodynamic potential). This minimum may be connected with the occurrence of additional valency forces (Hume-Rothery affinity) at definite concentrations. The magnitude of the minimum is of the order of the thermal effect during the admixture of metals. The further application of the theory to the calculation of the thermal course of the solubility (for the α-phase) gives results which agree qualitatively with the thermal data and enable the possible transformations in solid solutions of alloys with variable concentration of valency electrons to be anticipated. H. H. Ho.

3266. Free Energy of Iodine and Hydrogen Iodide from Spectroscopic Data. G. M. Murphy. *J. Chem. Phys.* 4. *pp.* 344–350, *June,* 1936.—Partition functions are calculated for HI, I_2 and I atoms between 298·1 and 1500° K. from spectroscopic data and the results are fitted to a free energy equation of the usual thermodynamic form which may be differentiated and integrated to give change of heat content, specific heat and entropy for chemical reactions involving HI, I_2, I and H_2. The experimentally determined equilibrium constants for the reactions $I_2 \rightarrow 2I$ and $HI \rightarrow \frac{1}{2}H_2 + \frac{1}{2}I_2$ are compared with the theoretical equilibrium constants. AUTHOR.

3267. Free Energy and the Rate of Chemical Reactions. H. Gershinowitz. *J. Chem. Phys.* 4. *pp.* 363–366, *June,* 1936.—The theories of the rates of chemical reactions previously developed by Eyring, Rice and the author [see Abstract **3947** (1935)] give a relationship between the rate of reaction and the free energy of formation of the activated state. With the aid of this relation it is possible to explain the experimental data which have shown that there is a connection between the rates of oxidation-reduction reactions and the potentials of the reagents used. AUTHOR.

3268. Derivation of the Nernst Theorem. R. Brunner. *Zeits. f. Physik,* 100. 9–10. *pp.* 584–593, 1936.—The author shows how the general data for the formation of the definite integral from the Gibbs-Helmholtz equation may be found, and thence proceeds to the general determination of the entropy constant. It follows from the considerations advanced that a fourth law of thermodynamics is not possible, and that the Nernst theorem has equal status with the first two laws. H. H. Ho.

3269. Joule-Thomson Coefficient of Carbon Dioxide. Tzu Ching Huang, Feng Lin and Cheng Yi Fu. *Zeits. f. Physik,* 100. 9–10. *pp.* 594–598, 1936.—The Joule-Thomson effect for CO_2 is derived from Scatchard's modification of the Beattie-Bridgeman equation of state with pressure and temperature as independent variables, each quantity being expressed by the customary thermodynamical expressions. The calculations are assembled in tabular form and compared with the exact data obtained by Burnett for the Joule-Thomson effect for CO_2. The agreement is satisfactory for temperatures above 270° K. and for pressures below 20 atmospheres. H. H. Ho.

3270. Thermodynamic Properties of Cadmium Sulphate in Water-Ethyl Alcohol Solutions. V. K. La Mer and E. L. Carpenter. *J. Phys. Chem.* 40. *pp.* 287–302, *March,* 1936.—E.m.f. measurements are made upon the cell Cd (2-phase amalgam)| $CdSO_4$ (M, *a* % of EtOH) | $HgSO_4$ (S) | Hg, for $M = 0{\cdot}01$ and $a = 33{\cdot}3$ and 50 at 0, 10, 15, 20 and 30° C.; as a function of M with $a = 33{\cdot}3$ at 25° C.; and for $M = 0{\cdot}01$ and $a = 15$ at 25° C. The cell Pb (2-phase amalgam) | $PbSO_4$ (S) | $HgSO_4$ (S) | Hg is also investigated at 12·5°C. intervals from 0°C. to 50° C. The partial heat contents and the partial heat capacities of cadmium sulphate in the alcoholic solutions are calculated for comparison with the corresponding aqueous solutions. The total medium effect for 0·01 $CdSO_4$ in 15, 33·3 and 50 % alcohol and the solvent and interaction medium effects in 33·3 % alcohol are evaluated, the results being considered in the light of the Born transfer equation and the extended form of the Debye-Hückel interaction theory. The value of the mean ionic radius of the Cd^{++} and SO_4^{--} ions, as calculated from the Born equation, is in fair agreement with the value of the closest approach of two ions calculated by means of the extended Debye-Hückel theory. L. A. W.

3271. Thermodynamics of Hydrochloric Acid in Methanol-Water Mixtures. H. S. Harned and H. C. Thomas. *Am. Chem. Soc., J.* 58. *pp.* 761–766, *May,* 1936.—E.m.f. measurements of the cells $H \mid HCl(m)$ in x % CH_3OH y % $H_2O \mid AgCl\text{-}Ag$ were made at 5 intervals from 0° to 40° C. The water solutions contained from 10 to 20 % by weight of methanol. The acid varied from 0·003 to 2 *M*. The densities of the solutions were determined, and the activity coefficient of the acid in these solutions was calculated. It was found that at a given temperature, the activity coefficient of the acid in the water-methanol mixtures could be calculated from the parameters of the equation of the extended Debye-Hückel theory which were obtained in aqueous solutions. F. J. B.

See also Abstracts 3045, 3061, 3272.

VAPOUR PRESSURE.

3272. Hydrocarbon Vapour Pressures. E. R. Cox. *Indust. and Engin. Chem.* 28. *pp.* 613–616, *May,* 1936.—The saturated vapour pressures of all hydrocarbons with molecular weights over 30, whose data are available, can be correlated by three equations, if boiling point and critical temperature and pressure are known; and the latter can be calculated for the normal paraffin series. AUTHOR.

See also Abstracts 2987, 3046, 3244.

ACOUSTICS.

***3273. High Acoustic Output from Valve-Driven Tuning Forks. C. Williamson and W. J. Eisenbeis.** *Am. Phys. Teacher*, 4. *pp.* 91–93, *May*, 1936.—Two valve circuits for driving tuning-forks are described. Each circuit is self-starting, and will provide large acoustic output. The first arrangement uses a microphone as pick-up, and an electromagnet as driver; the second an electromagnet as pick-up, and a loud-speaker as driver. Neither circuit is tuned; forks of frequencies from 128 to 1024 will drive without circuit readjustment. An effective amplitude control is provided. AUTHORS.

3274. Waves Propagated in the Atmosphere. K. Koenuma. *Imp. Marine Obs., Kobe, Japan, Mem.* 6. *pp.* 175–212, *March*, 1936. *In English.*—Lamb's treatment is extended to waves of short period, such as a few minutes. Assuming air to be a compressible medium, the propagation of waves in the atmosphere with a uniform temperature gradient is discussed. It is shown that with a given velocity the effect of the temperature gradient is to increase the period and the wave-length. In the second part waves incident on a surface of discontinuity are investigated, and it is shown that at a surface of temperature discontinuity, as the temperature difference increases the periods diminish. Further, the wave-length and velocity increase with the height of the discontinuous surface, although for a height of a few km. the period is nearly constant. G. E. A.

3275. Ultrasonic Velocities in Liquid Mixtures. S. Parthasarathy. *Indian Acad. Sci., Proc.* 3*A*. *pp.* 297–303, *April*, 1936.—The paper gives results and graphs of (*a*) ultrasonic velocities and (*b*) adiabatic compressibilities in the following four binary liquid mixtures in all of which one component is CCl_4; the second component being (1) benzene, (2) CS_2, (3) ethyl acetate and (4) tetralin. The variation of adiabatic compressibility of the mixture is found to be not always strictly proportional to concentration. These results are applied to experimental investigations in an earlier paper [see Abstract 3667 (1934)] where it was observed that the intensity of scattered light in binary liquid mixtures (completely miscible and at temperatures far removed from the critical solution temperature) was not always proportional to concentration. The trend of the curve in light-scattering and compressibility studies is the same, being concave or convex towards the concentration axis in both the cases, or being straight. The agreement is satisfactory. [See also Abstract 784 (1936).] AUTHOR.

3276. Absorption, Velocity and Degassing Effect of Supersonic Radiation in Liquids. C. Sörensen. *Ann. d. Physik*, 26. 2. *pp.* 121–137, *May*, 1936.—The liquids investigated are water, transformer oil, glycerin, and other organic liquids. Measurements are made at frequencies of 194, 380, 530 and 950 kc., sound intensities up to 5 W/cm^2. being obtained. The intensity in the liquid is measured by a balance method, which enables an absolute value of the intensity to be obtained without distortion of the sound field. Absorption measurements show, except in the case of water, an increase of absorption with frequency. Alcohol and other liquids show a variation of absorption with the intensity of the sound. Velocity measurements made by detecting the nodes in a stationary wave system with charcoal agreed with those obtained by workers using other methods. The absorption coefficient in water increases with the gas emission, and the amount of energy required to liberate 1 c.c. of gas is calculated. K. M. C.

3277. Absorption of Ultrasonic Radiation in Liquids. J. Claeys, J. Errera and H. Sack. *Comptes Rendus*, 202. *pp.* 1493–1494, *May* 4, 1936.—The absorption of ultrasonic radiation in water and a number of organic liquids is measured. The results confirm those given by Biquard ((*Thèse, Paris*, 1935), *viz.*, that the absorption may be up to 1000 times greater than that calculated from the classical formulæ. In the case of CS_2, which has a particularly high absorption, the addition of small quantities of CCl_4 materially reduces the absorption. Frequencies ranging from 0·3 to 2 megacycles are used for the measurements.

J. E. R. C.

***3278. Unidirectional Ultrasonic Radiator. J. Gruetzmacher.** *Zeits. f. techn. Physik*, 17. 5. *pp.* 166–167, 1936.—An oscillating quartz crystal normally radiates sound in both directions. By making an air cavity behind one face of the crystal a unidirectional beam may be obtained in the liquid in which the crystal is placed. The theory lying behind this is given and it is noted that the damping and energy input is decreased considerably in this way. J. E. R. C.

3279. Ultrasonic Research. E. Hiedemann. *V.D.I.* 80. *pp.* 581–586, *May* 16, 1936.—A comprehensive review of recent advances in the technique of ultrasonic aerial waves. The most important sources of such waves are piezoelectric crystals and magnetostriction oscillators. The phenomena associated with the waves are optical in character, and they are easily controlled. Applications are found in testing materials, in under-water signalling and depth-sounding by echo, and in colloid chemistry. There is also the possibility of using such waves for the improvement of metallic smelting. L. E. C. H.

3280. Raman and Nath's Theory of Diffraction of Light by Ultrasonic Waves. R. Bär. *Helv. Phys. Acta*, 9. *pp.* 265–284, *May* 7, 1936. *In German.*—Experiments were made to determine the limits within which the Raman-Nath theory holds [see Abstract 2309 (1936).] The theory is confirmed for waves of frequency 1500 kc./sec. so far as can be found by the photographic method employed. It therefore represents for the frequency range 1000 to 2000 kc./sec. a great step forward, and is probably capable of many applications. The theory has, however, only a qualitative application to waves of frequency 7500 kc./sec., particularly when oblique incidence of the light causes asymmetric distribution of the light intensity in the diffraction spectra. Additional experiments are described on the production of stationary ultrasonic waves, which confirm and extend previous observations [see Abstract 270 (1936)]. Photographic reproductions of the diffraction spectra are given. G. E. A.

3281. Aerosols in Acoustic Field. O. Brandt and E. Hiedemann. *Kolloid Zeits.* 75. *pp.* 129–135, *May*, 1936.—It is found that aerosols can be rapidly coagulated and precipitated by sound and ultrasound waves, and that a frequency range of 5 to 50 kc. is particularly favourable. The behaviour of the suspended particles in the acoustic field is investigated by means of microphotographic and microkinematographic methods, of which full experimental details with diagrams and illustrations are included. The aggregation takes place within the gaseous space. Particle increase in the acoustic field is determined by rate of sedimentation and light absorption measurements. The results afforded by both methods agree within dimensional order and indicate that an increase of the suspended particles by several hundredfold can be easily attained. With greater sound intensities, the particles may be precipitated from rapidly moving aerosol currents. H. H. Ho.

3282. Influence of Ultrasonic Waves on Gels. H. Freundlich and K. Söllner. *Faraday Soc., Trans.* 32. *pp.* 966–970, *June,* 1936.—The liquefaction of thixotropic gels and the peptisation of gels in general by ultrasonic waves are due to the same effect as emulsification in non-metallic systems, *i.e.*, they are due to cavitation. If the latter is prevented, either by external pressure or by experimenting *in vacuo,* no liquefaction and no peptisation is observed, when irradiating with ultrasonics. AUTHORS.

3283. Acoustics of Halls. G. W. C. Kaye. *Roy. Soc. Arts, J.* 84. *pp.* 678–698; *Disc.*, 698–699, *May* 15, 1936. *Engineering,* 141. *pp.* 465–466, *April* 24, 1936.—An account is given of the principles of designing and constructing auditoria in order to achieve good acoustical conditions. J. E. R. C.

3284. Threshold of Hearing by the Thermophone and Measurements at the Tympanum. E. Waetzmann and L. Keibs. *Ann. d. Physik,* 26. 2. *pp.* 141–144, *May,* 1936.—Reference is made to Békésy's measurements [see Abstract 1774 (1936)] and an account is given of tests made on one person. Curves for the two ears show that the threshold has a minimum value at a frequency about 1100, when the effective pressure at the tympanum is somewhat less than 10^{-4} dyne/cm^2. The variation of the absorption coefficient with frequency is such that the absorption is roughly constant between the frequencies 100 and 400, and increases considerably between 400 and 1600. Curves of phase-change with frequency show a gradual increase in the change of phase between the incident and reflected waves to a maximum at a frequency of about 1100. A table of transmission factors and their components is given for frequencies from 100 to 1600. G. E. A.

3285. Formants. O. Vierling. *Ann. d. Physik,* 26. 3. *pp.* 219–232, *June,* 1936.—Helmholtz has shown that the characteristic sound of a vowel is due to certain partials which are particularly strong in a certain frequency region. Willis (1832) and Hermann (1889–1913) maintained that certain tones, called mouth tones, determined the vowel sound. These tones were not harmonics of the fundamental, and Hermann named them formants. Stumpf applies the name formant to the range of tones whose combined effect characterises any given vowel sound. The author adds certain other characteristics to the formant. Its frequency is that of the resonance curve which contains the group of partials involved, and its damping is that of this resonance curve. The formant is caused by resonance; it occurs through the prominence of partials which are present in the original sound, and its intensity depends not only on the properties of the resonance structure, but also on the number and intensity of the partials of the original sound which fall within the resonance region. G. E. A.

3286. Vibro-Tactile Phenomena. R. H. Gault. *Frank. Inst., J.* 221. *pp.* 703–719, *June,* 1936.—The paper reports experimental studies on the mechanical stimulation of certain sense organs by patterns of vibration (corresponding to speech and to music) in a solid body in contact with the skin of the finger tip; and the ability of human subjects to discriminate between such patterns of stimuli. The vibrations are amplified to conform as much as possible with desiderata already reported [see Abstract 744 (1934)] and the author shows that characteristics of spoken language such as emphasis are more successfully interpreted by his " Teletactor " [see Abstract 3838 (1934)] than by a lip reader's eye alone. It is found possible to locate the direction of a sound by feeding the amplified currents derived from two microphones in close proximity into two teletactors to which respectively the left and right index fingers are applied. Experiments preliminary to the detailed study of masking in the vibrotactile sphere are reported, and the need for finding the optimum pressure and area of stimulation is indicated. [See also Abstract **3362** (1934).]

E. J. I.

***3287. Mechanical Slide Illustrating Wave Motion. E. J. Irons.** *Journ. Sci. Instruments*, **13.** *pp.* 184–189, *June*, 1936.—The paper describes a device whereby two co-planar lantern slides may be made to move simultaneously either parallel or at right angles to each other. Designed primarily to illustrate a course of lectures on sound, the apparatus is particularly suited to meet the requirements of non-mathematical students, besides affording a graphical interpretation to the results of an analytical development. It may be used for individual instruction or, in conjunction with a projection lantern, for class purposes. Provision is also made for the use of circular plates, and details are given of a number of slides illustrating acoustical phenomena. AUTHOR.

See also Abstracts **3024, 3025, 3333, 3342.**

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

***3288. Measurement of Impedance. K. Karandejew.** *Techn. Phys., U.S.S.R.* 3. 3. *pp.* 249–254, 1936. *In German.*—The unknown impedance is placed in parallel with a known variable impedance, and the currents through the two are balanced by means of differential thermojunctions. [See Abstract 2902 (1936).] L. H.

***3289. Luminous Quartz-Resonators as Visual Detectors in R.F. Bridge Measurements of Skin Effect. F. Krüger.** *Ann. d. Physik,* 26. 2. *pp.* 167–176, *May,* 1936.—A 4-arm bridge is used for measurements of the skin effect in specimens of iron and mu-metal wires over a frequency range extending from 35 to 1000 kc. The p.d. between the detector points is applied to a 3-stage tuned amplifier which is connected to a set of luminous quartz-resonators. The observations are taken at 12 frequencies corresponding to the resonant frequencies of the resonators. The results give good agreement with Stefan's formula for the skin effect in wires, the effective resistance for frequencies sufficiently high being proportional to the square root of the frequency. The permeability of both iron and mu-metal in this frequency range is very small and practically constant, a result anticipated by earlier investigations. T. I. J.

See also Abstracts **3300, 3320.**

CONDUCTION AND DISCHARGE IN GASES.

3290. Effect of H.F. Oscillations on the Positive Point Discharge. W. Deutsch. *Ann. d. Physik,* 26. 3. *pp.* 193–218, *June,* 1936.—The effect of h.f. oscillations on point-plane discharges was investigated for wave-lengths in the range from about 7 to 250 m. In all cases the point was given a positive potential with respect to the plane. The effects of variation of h.f. energy, wave-length and potential are exhibited in diagrams. The effect was found to be greatest for a wave-length of about 50 m. The results are discussed in relation to Jaumann's original investigations of similar phenomena, carried out in 1888. A. W.

3291. Transition from Laminar to Turbulent Convection Streaming in High Pressure Discharge Tubes. W. Elenbaas. *Physica,* 3. *pp.* 484–490, *June,* 1936. *In German.*—The unsteadiness of a high pressure Hg discharge, when the pressure or the diameter exceeds a certain value is attributed to the fact that the convection streaming, which is at first laminar, becomes turbulent. The amount of Hg per cm. length of the discharge tube, for which the unsteadiness appears as some function of the diameter, agrees for diameters greater than 1 cm. with the calculated amount. The Reynolds number deduced from the amounts of Hg at which unsteadiness sets in is of the order of the Reynolds number at which turbulence occurs. H. J. H. S.

3292. Polarisation Effect in Discharge-Tubes. J. Thomson. *Phil. Mag.* 21. *pp.* 1057–1066, *June,* 1936.—It is shown that the sparking potential of a discharge-tube depends upon the nature of the discharge which has been passed through it previously, and that the passage of a h.f. discharge may produce systematic variations in the " normal " sparking potential. By passing a h.f. discharge before reading the static sparking potential (the sparking potential when a steady p.d. is applied across the tube, and is very slowly increased), it is possible to make the mode of variation of the latter with the gas pressure obey the equation $V_s = A + Bp$ at pressures greater than twice the critical value. In view of the fact that the sparking potential, using h.f. alternating potentials, obeys a similar law, it is suggested that this equation represents the state of affairs when the surfaces of the electrodes remain the same throughout the experiment, and that, therefore, the value of the number A depends upon the electrodes, while the value of B depends only upon the gas. AUTHOR.

3293. Electron Temperature in the Positive Column in a Mixture of Neon and Sodium. W. Uyterhoeven and C. Verburg. *Comptes Rendus*, 202. *pp.* 1498–1500, *May* 4, 1936.—Introducing probe electrodes into a Ne-Na discharge the electron temperature (T_e) is measured relative to the temperature (T_w) of the outer wall of the tube. As T_w is increased the electron temperature near the wall of the tube increases to a maximum of 22,500° K. (at $T_w = 240°$ C.). This increase of the maximum value of T_e above that for pure Ne (19,500° K.) is attributed to the alteration in the distribution of the current density due to the introduction into the discharge of easily ionised atoms. [See Abstract 1771 (1935).] A. J. S.

3294. Temperature Dependence of Kathode Atomisation. N. D. Morgulis, M. P. Bernadiner and A. M. Patiocha. *Phys. Zeits. d. Sowjetunion*, 9. 4. *pp.* 302–316, 1936. *In German.*—An experimental method is specially developed for the investigation of the dependence on temperature of the critical potential of atomisation and of the degree of atomisation at the kathode in a discharge chamber. It is found that the critical potential of atomisation of thoriated W by Hg ions between 1350° and 1750° K., and also the degree of atomisation of pure W by Hg ions between 800° and 2000° K. is practically independent of the temperature of the kathode. A. W.

***3295. Ionisation of Molecular Rays by Electron Collision. N. Sasaki and E. Nishibori.** *Imp. Acad. Tokyo, Proc.* 12. *pp.* 13–15, *Jan.*, 1936. *In German.*—An apparatus is described which comprises means for producing a narrow beam of molecular rays and for bombarding this beam with electrons which form a second beam crossing the first beam at right angles. The ions produced by collision between electrons and molecules are accelerated in the direction of the molecular beam to pass into a mass-spectrograph where the different ionic currents are measured by an electrometer. Results of an investigation of the ionisation of an atomic beam of Hg are outlined. The ionic current is found to be approximately proportional both to beam intensity and electron current, the ionisation probability agrees well with the value measured by Bleakney [see Abstract 2281 (1930)]. Analysis of the ions produced by 120-V electrons and accelerated to 130 V with a magnetic field of 1650 gauss gives a current-voltage curve with two clear maxima corresponding to Hg^+ and Hg^{+++}. Hg^{++} lies in the depression between these maxima—this is expected from Bleakney's measurements. J. E. K.

***3296. Comparative Properties of Soft and Hard Kathode-Ray Tubes. L. H. Bedford.** *Journ. Sci. Instruments*, 13. *pp.* 177–184, *June*, 1936.—The operation of the above two types of kathode-ray tubes is described from a common theoretical viewpoint and their properties are compared and contrasted. The various points considered are (*a*) the electron-optical effect of the electron beam ; (*b*) deflection conditions ; (*c*) sensitivity ; (*d*) defocusing ; (*e*) frequency range ; (*f*) origin distortion. It is considered that both gasfilled and hard tubes will continue to be required, each having a specific field of application. A. W.

3297. Potential of an Insulated Screen Due to Electron Bombardment in a High Vacuum. H. Strübig. *Phys. Zeits.* 37. *pp.* 402–409, *June* 1, 1936.—The charging of a metal screen subjected to electron bombardment in a high vacuum is investigated, potential measurements being made with an electrostatic voltmeter. It is found that a screen under such conditions always becomes positively charged and with increasing anode potential the screen potential also increases to a value depending on the screen material and the exit angle of the electrons and approximating to the anode potential. The theory is advanced that for this value of the screen potential the secondary emission equals the primary emission and observations of the kink in the anode-screen potential diagram confirm this view. In order to obtain reproducible measurements the effect of heating *in vacuo* is investigated. After heating it is found that the secondary emission is relatively large, decreasing with electron bombardment along an exponential curve to a reproducible value. After repeated heatings the secondary emission again increases. The theoretical conclusion that for low potentials up to about 85 volts the plate should remain at zero potential is confirmed by experiment. An explanation of the fact that increase of brightness of luminous substances stops for some particular potential is based on the results obtained for metal screens, from which the behaviour of luminous screens may be inferred. A. W.

3298. Formation of Ammonia by the Collision of Positive Ions. I. Motschan, S. Roginsky, A. Schechter and P. Theodorof. *Acta Physicochimica,* 4. 5. *pp.* 757–766, 1936. *In German.*—The possibility of an NH_3 synthesis by the impact of positive ions of the alkali metals (Li, Na, K, Rb, Cs) is established, and details of apparatus with data and diagrams are given. It is found that sharp definite critical potentials of the ions exist which are necessary for the initiation of the reaction. Various possible mechanisms of the primary activation are analysed and compared with the results obtained by the initiation of reactions through electronic impact and electrical discharge. H. H. Ho.

3299. Chemical Reactions between Nitrogen and Oxygen in H. F. Discharge. A. A. Balandin, J. T. Eidus and N. G. Zalogin. *Acta Physicochimica,* 4. 3. *pp.* 365–394, 1936. *In German.*—The formation of nitrogen oxides from N_2–O_2 under the influence of h.f. discharge is investigated. At first O_3 and N_2O_5 form and collect ; later the decomposition of O_3 is accelerated. When the velocity of decomposition attains a maximum value, N_2O_5 begins to change into NO_2. The reactions run in accordance with a chain mechanism. J. K.

***3300. Valve Circuit for Registration of Counter Coincidences. G. Bernardini and O. Bocciarelli.** *Accad. Lincei, Atti,* 23. *pp.* 265–269, *Feb.* 16, 1936.—Continuing previous work [see Abstract 4349 (1935)], a coincidence arrangement of two aluminium counters is used to determine the range of protons projected from cellophane by the impact of α-particles from polonium. A maximum range of 12·4 cm. is found in agreement with previous workers. F. C. C.

See also Abstracts 3163, 3201.

CONDUCTION IN SOLIDS AND LIQUIDS.

3301. Current Conduction by Convection and Diffusion. Part II. F. Borgnis. *Zeits. f. Physik,* 100. 7–8. *pp.* 478–512, 1936.—The problem of unipolar conduction in a dielectric medium is treated by rigorous consideration of the diffusion. From the general solution, which is worked out for any external current, simplifications are given for the physically interesting cases which facilitate a quantitative investigation. The theoretical results are compared with the results of experimental work on current conduction in dielectric liquids and gases at higher pressures. [For Part I see Abstract 2828 (1936).] R. L.

***3302. Photoelectric Voltage Compensation and Resistance Measurement. P. Wulff.** *Phys. Zeits.* 37. *pp.* 269–271, *April* 15, 1936.—A circuit is described suitable for the measurement of thermo- and other e.m.f.s. The voltage to be measured is applied to a mirror galvanometer in series with a rectifier photo-cell. The photo-cell is illuminated by a beam of light reflected from the mirror, and the photo-e.m.f., which is measured by a suitable millivoltmeter, compensates the applied voltage. The accuracy is discussed. A circuit, on similar principles, for the measurement of resistance is also described. Here two cells are used, forming two arms of a Wheatstone bridge, the light reflected from a mirror galvanometer, which occupies the usual position of the galvanometer in a Wheatstone bridge, being divided between the two cells. No battery is required in the circuit, and the ratio of the resistances in the other two arms of the circuit is given by the ratio of the photo-e.m.f.s of the two cells. D. H. F.

3303. Measurement of Electrical Impulse by Ballistic Galvanometer. H. Wittke. *Ann. d. Physik,* 26. 2. *pp.* 138–140, *May,* 1936.—Instead of the usual assumption that the whole of a transient current has passed before the suspension of a ballistic galvanometer has been set in motion, the author works out a correction to be applied to the usual formula assuming an exponentially decaying current. K. M. C.

3304. Validity of Ohm's Law for Metals at High Current-Densities. H. M. Barlow. *Phys. Soc., Proc.* 48. *pp.* 549–559 ; *Disc.,* 559–562, *July* 1, 1936.—The paper describes experiments in which simultaneous measurements are made of the resistances of a gold conductor to a large d.c. and a relatively small a.c. of radio frequency. At such frequencies the temperature of the conductor is found to remain practically constant in spite of the periodic nature of the heating effect produced by the a.c. Thus any difference between the a.-c. and d.-c. resistances indicated a departure from Ohm's law, the skin effect being negligible. The experiments showed that the resistance of a gold conductor at constant temperature rises at very high current-densities and that the amount by which it rises increases with the temperature. The tests were made at current-densities which reached 6×10^6 A./cm^2. AUTHOR.

***3305. Effect of Mechanical Deformation on Properties of Copper-Oxide Rectifiers. J. Dunaev and D. Nasledov.** *Techn. Phys., U.S.S.R.* 3. 3. *pp.* 268–278, 1936. *In English.*—The authors study the effects of bending on copper-oxide rectifiers and show that after the first bend, with the cuprous oxide on the concave surface, the current in the closed direction is increased. After the second bend, the cuprous oxide is on the convex surface and the current is increased enormously ; after the third bend the oxide is concave and the current is increased another two-fold. After a further bend the oxide is convex and the current is decreased, while after the fifth bend the current is increased again. The fundamental cause of the changes in the current in the closed direction is the mechanical damage to the blocking layer. In the case of the current in the reverse direction there is no effect, since the resistance of the copper oxide itself is the determining factor. [See also Abstract 3162 (1933).] E. T. A. R.

3306. Electrical Resistance of Gold at Low Temperatures in a Transverse Magnetic Field. E. Justi and H. Scheffers. *Phys. Zeits.* 37. *pp.* 383–384, *May* 15, 1936.—A preliminary report is given of the resistance of Au single crystals at 20·38° and 14·00° Abs. in magnetic fields up to 22 kG. The experimental arrangement is similar to that of Meissner and Scheffers [see Abstract 1554 (1930)], but the accuracy is said to be greater owing to the use of a new highly sensitive galvanometer. Polar curves of the results are given showing that the ratio of the resistances with and without magnetic field varies with the direction of transverse magnetic field. The results are briefly discussed. [See also Abstract 2907 (1930).] R. L.

3307. Electrical Resistance of Gold and Silver at Low Temperatures. W. J. de Haas and G. J. van den Berg. *K. Onnes. Lab. Leiden, Comm. No.* 241*d*. *Physica*, 3. *pp.* 440–449, *June*, 1936. *In English.*—In accordance with the earlier measurements [see Abstract 853 (1935)] the resistance curves of the gold wires measured show a minimum. The " ideal " resistance calculated by means of Matthiessen's rule, without taking into account the points below the temperature of the minimum, grows proportionally to $T^{4.2}$. The minimum shifts to higher temperatures, when the residual resistance grows. One of the samples of pure silver shows a minimum too. The " ideal " resistance, calculated in the same way as for gold, grows proportionally to $T^{4.1}$. AUTHORS.

3308. Latent Heat of Tin in Passing from the Supraconductive to the Non-Supraconductive State. W. H. Keesom and P. H. van Laer. *K. Onnes. Lab. Leiden, Comm. No.* 242*a*. *Physica*, 3. *pp.* 371–384, *June*, 1936. *In English.*—The results are given of latent heat measurements made on tin in connection with the transition from the supraconductive to the non-supraconductive state while a constant magnetic field is being applied. The range of the transition region as demonstrated by the occurrence of the transition heat agrees almost exactly with what can be calculated in connection with the form of the block. It is concluded, that in the transition, if performed in this way, no irreversible heat process takes place. The way in which the magnetic field penetrates into the block is considered. Some measurements of the latent heat are made at constant temperature. The results are discussed. AUTHORS.

3309. Transition of a Tin Sphere from the Non-supraconductive to the Supraconductive State. W. J. de Haas and O. A. Guinau. *K. Onnes. Lab. Leiden, Comm. No.* 241*b*. *Physica*, 3. *pp.* 534–542, *June*, 1936. *In English.*—Two cases are studied in both of which a non-supraconductive tin sphere changes into the supraconductive state. It is shown that the changes of field strength at these transitions show much analogy with those of the opposite transition. Yet the phenomena are not exactly reversible. Lippmann's rule is not valid in the body of the sphere. The currents which should be responsible for the distribution of the field strengths found have directions opposite to those predicted from Lippmann's rule. [See Abstract 1809 (1936).] AUTHORS.

3310. Magnetic Hysteresis and Time Effects in Supraconductors. K. Mendelssohn and R. B. Pontius. *Physica*, 3. *pp*. 327–331, *May*, 1936. *In English.*—Two kinds of magnetic hysteresis in supraconductors are distinguishable. The first, which the " freezing-in " of a part of the flux of force produces, is ascribed to a supraconducting ring-shaped region of high threshold value. This form of hysteresis seems to occur especially in impure polycrystalline substances. The second type can be considered as a super-cooling of a condition in the other. This hysteresis was observed in single crystals or specimens which were very pure and probably consisted of a few large crystals. In connection with the setting-in of super-cooling the fact seems to be that after a sudden change of the variable condition the establishment of equilibrium between supraconducting and non-supraconducting material requires considerable time. J. J. S.

3311. Theory of Magnetic Fields in Supraconductors. F. London. *Physica*, 3. *pp*. 450–462, *June*, 1936. *In German.*—Starting from the theory of the pure supraconductive state a theory of the " intermediate " state is developed, the characteristic feature of which is the appearance of a macroscopic magnetic induction B. Considering the surface energy of the pure supraconductive state, as postulated by Gorter and H. London, the energy density of such an " intermediate " state is calculated to be given by: $U = -H_r^2/2 + H_r|B|$. ($|B| \leq H_r$), (H_r= magnetic threshold value). AUTHOR.

3312. Electrical Conductivity and Phase-Diagram of Na-Pb Alloys. H. Klaiber. *Zeits. f. Elektrochem.* 42. *pp*. 258–264, *May*, 1936. —The phase-diagram of the Na-Pb alloys is thoroughly investigated from various aspects. The present method of investigation consists in observing temperature resistance curves for a range of Na-Pb alloys from 0–50 atomic % Na. The phase diagram for various proportions of the constituents of the alloys is given as well as experimental data and curves. [See Abstract 2352 (1936).] J. E. B.

3313. Electrical Conductivity of the Oxides of Co and Fe, and Recrystallisation of ZnO. C. Wagner and E. Koch. *Zeits. f. phys. Chem.* 32. *Abt.B*. 6. *pp*. 439–446, 1936.—Oxides of Co and Fe may exist with an excess O_2 content, implying that the O lattice is complete, while gaps exist in the metal lattice. At high temperatures the conductivity of Co_3O_4, Fe_3O_4 and FeO is practically independent of the oxygen pressure. At room-temperature, conductivities of CO_3O_4 and Fe_3O_4 vary considerably according to the previous thermal history of the specimen, which governs the O_2 content. Co_3O_4 possesses a spinel-type lattice and the mechanism of oxygen adjustment may be an electron transfer between $Co^{\cdot\cdot}$ and $Co^{\cdot\cdot\cdot}$. Magnetite from 4 % Si dynamo steel showed little difference in values at higher temperatures and gave 52 Ω^{-1} cm^{-1}. at room-temperature, hence the effect of the small quantities of impurity in electrolytic Fe would probably be negligible. ZnO in H_2 at 450° C. shows intensified recrystallisation compared with an O_2 atmosphere. This must be explained by transport of matter in the gaseous phase, Zn as vapour, O_2 as H_2O, and not by defect phenomena : $Zn_{(unstable,\ solid)} + H_{2\,(gas)} \rightarrow Zn_{(gas)} + H_2O_{(gas)} \rightarrow ZnO_{(solid,\ stable)} + H_{2(gas)}$. D. R. H.

3314. Electrical Conductivities of Aqueous Solutions of Sodium Dodecyl- and Hexadecyl-Sulphates. O. R. Howell and H. G. B. Robinson. *Roy. Soc., Proc.* 155*A*. *pp*. 386–406, *June* 2, 1936.—Electrical conductivities are measured over a wide concentration range at different

temperatures between 20° and 100° C. by the method previously described [see Abstract 3168 (1933)]. The conductivity is plotted against the square root of the concentration, and, at each temperature, the curve consists of three distinct ranges. Over the first range the fall of conductivity is linear as for simple electrolytes; the alkyl sulphate is therefore completely ionised and the fall of conductivity is due to ion interaction as postulated by Debye and Hückel. Over the second range the fall of conductivity is extremely rapid. It is suggested that the anions form a loose network, through which the kations are unable to move freely; the network becomes more densely packed with increasing concentration, causing a decrease in conductivity. Over the third range the conductivity rises to a small maximum and falls again. This is attributed to micelle formation.
C. J. B. C.

***3315. Conductivity of Highly-Diluted Electrolytic Solutions. W. Grallert.** *Zeits. f. Elektrochem.* 42. *pp.* 330–336, *June,* 1936.—A method of measuring electrolytic resistance covering a range 10^4 to 10^6 ohms is described together with a close study of the best conditions for setting up the bridge used, and an examination of the sources and extent of error. A suitable l.f. generator for the bridge is described. The cost of the equipment has been purposely kept low, while good accuracy is attained.
J. E. B.

See also Abstracts 2930, 2972, 2996, 3289, 3327, 3347, 3366.

DIELECTRICS AND CAPACITANCE.

3316. Theory of Polarisation of Dipole Liquids. J. Frenkel. *Acta Physicochimica,* 4. 3. *pp.* 341–356, 1936. *In German.*—The author considers the recent theory put forward by Debye to explain anomalies observed in the polarisation of dipole liquids. The treatment is similar to a previous theory proposed by the author to explain the translatory motion of atoms and ions in liquids. Expressions are derived mathematically for the elastic (static) effect and the kinetic or frictional effect in the orientation of dipole molecules in liquids. The range of validity of the frictional theory for small molecules is also considered.
A. M. T.

3317. Dipole Moments of Alkali Halides. W. H. Rodebush, L. A. Murray, Jr., and M. E. Bixler. *J. Chem. Phys.* 4. *pp.* 372–376, *June,* 1936.—The dipole moments have been determined by the molecular-beam method by calculation from the percentage decrease in maximum intensity of the beam when the field is applied. The values of the dipole moments of KCl, KBr, KI and CsI are 9·7, 10·8, 11 and $12 \cdot 1 \times 10^{-18}$, which are higher than those reported by Scheffers [see Abstract 3007 (1934)]. It is concluded that the salt vapours contain single molecules only, and that a mixture of the ionic and homopolar types of bonding exists in salt molecules.
E. R.

3318. Dielectric Constant of Liquid Ammonia. H. M. Grubb, J. F. Chittum and H. Hunt. *Am. Chem. Soc., J.* 58. *p.* 776, *May,* 1936.—The dielectric constant of liquid ammonia at 5, 15, 25 and 35° has been determined.
AUTHORS.

3319. Dispersion and Absorption of Nitrobenzene and Sugars. W. Dahms. *Ann. d. Physik,* 26. 2. *pp.* 177–192, *May,* 1936.—Measurements are reported by the Barretter arrangement of Wien, on nitrobenzene (including mixtures with benzyl benzoate) and solutions of cane sugar and levulose. Wave-length is extended down to 200 cm. The results, which are reported fully in tables and curves, show that whereas nitrobenzene fits well with Debye's theory, the sugars are anomalous. The absorption of levulose in concentrated solutions increases as the frequency, not approximately as its square, as is required by dipole theory. The dielectric constant of cane sugar appears not to vary with frequency; that of levulose falls considerably as the frequency increases. W. H. W.

***3320. H.F. Measurements of Dielectric Constant and Absorption Coefficient. W. I. Romanow.** *Phys. Zeits. d. Sowjetunion,* 9. 4. *pp.* 362–382, 1936. *In German.*—A detailed mathematical analysis is given of the second method of Drude, *i.e.*, the use of a Lecher wire system, across which is connected a condenser containing the material to be measured. Particular attention is paid to the influence of the glass vessel commonly used to contain the test condenser in work on liquids. Experimental evidence is given, showing by its consistence that the theoretical work is correct. W. H. W.

3321. Critical Field of Dielectric. F. Cernuschi. *Cambridge Phil. Soc., Proc.* 32. *pp.* 276–280, *May,* 1936.—Zener's reasoning [see Abstract 3398 (1934)] is criticised, and the above problem is studied in a different way. The metal model perturbed by an external electric field, studied by Kronig and Penney [see Abstract 2174 (1931)] is taken, and a value is obtained for the probability of transition of one electron through a zone of forbidden energy. In the case of an energy gap of 5 eV, the critical field when the breakdown begins is of the order of 10^7 V/cm. G. E. A.

See also Abstracts 3235, 3288, 3301, 3327.

ELECTROCHEMISTRY.

3322. Ionic Equilibria in Solutions. I. I. Saslawsky. *Zeits. f. Physik,* 100. 5–6. *pp.* 345–359, 1936.—The degrees of ionic dissociation of a number of monobasic acids in aqueous solution are determined by volumetric and refractometric methods. The quantity measured is either the change of volume or the change of refractive index when the acid is neutralised with KOH or NaOH (assumed completely ionised). The ratio of this change to the corresponding change occurring on neutralisation of HNO_3 (assumed completely ionised) is taken as a measure of the degree of ionisation of the acid in question. It is pointed out that determinations of heats of neutralisation lead to analogous results. The volumetric method shows that the degree of ionisation of partially ionised acids increases with the dilution. Volumetric and refractometric studies of the interaction of one base with two acids lead to the conclusion that some of the ions of which these methods take account have greater freedom than others. L. A. W.

3323. Electrolysis of Methyl-Magnesium Halides in Ether Solutions. W. V. Evans and E. Field. *Am. Chem. Soc., J.* 58. *pp.* 720–724, *May,* 1936.—The gaseous products are predominantly CH_4 and C_2H_6, the remaining 1 to 4 % being C_2H_4 and CO_2, which are definitely produced from the solvent ether. The proportion of C_2H_6 increases rapidly with current density to a limiting value, unaffected by concentration. The bromides and iodides are similar in this respect. The solvent ether provides the H for the formation of CH_4 and undergoes decomposition. The efficiency of the electrolysis is inversely proportional to the concentration above a limiting concentration. The chloride is the most efficient, bromide next and iodide least. An ionic mechanism is suggested. AUTHORS.

3324. Electrolysis of Manganous Salts. M. Geloso and (Miss) C. Rouillard. *Comptes Rendus,* 202. *pp.* 1418–1421, *April* 27, *and pp.* 1573–1575, *May* 11, 1936.—The course of electrolysis of solutions of $MnSO_4$ and $Mn(NO_3)_2$ with Pt anode is shown by (anodic) potential-current curves for different concentrations. These consist of two curved portions convex to the axis of potential, I ($v \ngtr$ about 1·3) and II ($v \nless$ about 1·6). During I Mn^{++} is oxidised to Mn^{IV} and MnO_2 is deposited, $Mn^{++} + 2H_2O \rightarrow MnO_2 + 4H^+ + 2e$; whence the normal potential of a MnO_2 electrode in Mn^{++} solution is deduced as 1·40 V. During the second portion O_2 is evolved in amount increasing with c.d., $2OH \rightarrow H_2O + \frac{1}{2}O_2 + 2e$, and "$MnO_2$" continues to be deposited. The deposit is not true MnO_2, but $MnO_2 \cdot nMnO$ with n always < 1 (0·047 – 0·27 in the examples given): n decreases with increase in time of electrolysis and acidity, and increases with concentration of Mn^{++} salt. This is due to partial hydrolysis of the Mn^{++} salt with formation of $Mn(OH)_2$ which is adsorbed by the MnO_2. Reckoning yield as percentage of Mn^{IV} deposited to theoretical it is nearly 100 % along I, but distinctly less along II, where part of the current is carried by the (OH) ions. C. A. S.

3325. Electrolysis by Spark and Faraday's Law. P. Jolibois and P. de Beco. *Comptes Rendus,* 202. *pp.* 1496–1498, *May* 4, 1936.—With the same arrangement [see Abstract 2725 (1935)] it is shown that Faraday's law is obeyed provided that diffusion of acid produced at the positive pole is prevented, that the spark is formed in an inert gas, *e.g.*, pure N_2, that only the weight of oxide formed is considered (*e.g.*, when with $CuSO_4 \cdot$aq. a basic sulphate is formed), and that the solution is saturated with oxide to begin with. C. A. S.

3326. Electrolytic Oxidation of Sodium Chloride to Chlorate. L. Delavenna and J. Maillard. *Comptes Rendus,* 202. *pp.* 1663–1664, *May* 18, 1936.—The electrolytic production of $NaClO_3$ from NcCl is improved, if evolution of Cl_2 is checked by rapid circulation of the electrolyte, and also by working under pressure, *e.g.*, of 400 cm. of water, by high anodic current density, and by cooling. An arrangement is described with anode of Pt gauze forming the axis of a steel cylinder which is the kathode, to give effect to these conditions, whereby a 95 % yield is obtained when working at 0°. This is reduced to 83 % if the temperature rises to 15°, and a similar result follows decrease in saturation with Cl_2. The adverse effect of a higher temperature is largely counteracted by addition of a small amount of HCl. C. A. S.

3327. Dielectric Properties of Aluminium Oxide. G. Franckenstein. *Ann. d. Physik,* 26. 1. *pp.* 17–54, *May,* 1936.—The d.c. properties of Al_2O_3 films produced by electrolytic means are studied. The surface conductivity, which is shown to be independent of the structure, is increased by an increase in applied voltage or atmospheric humidity. The volume conductivity varies with the film thickness, being greater for thicker films. It increases exponentially at high field strengths, obeying Poole's law, and increases considerably when the temperature exceeds 200° C. The volume resistivity of thoroughly dried Al_2O_3 film of thickness 50 μ is 4×10^{15} ohm/cm. at 20° C. The dielectric strength also varies according to the film thickness. For thin films of thickness not exceeding 50 μ, breakdown is due to breakdown of air in the pores of the material;

for thicker films breakdown is purely thermal. The electric strength of a film of thickness 100 μ is given as 330 kV/cm. Measurements of the absorption currents and back e.m.f. are also reported. E. R.

3328. Emission of Ultra-Violet Radiation in Anodic Oxidation of Aluminium. R. Audubert and O. Viktorin. *Comptes Rendus,* 202. *pp.* 1504–1507, *May* 4, 1936.—The radiation emitted with an Al anode in solution of $(NH_4)_2 HPO_4$ as electrolyte was observed by means of counters with photo-kathodes of Al or CuI [see Abstract 2072 (1935)]. The intensity of the electrolytic current decreases rapidly through formation of a pellicle of Al_2O_3. Emission of radiation was greatest before this pellicle was formed, but luminescence appeared only after it had formed and resistance had thus greatly increased. When the Al was the kathode there was no radiation. It is concluded that the emission of radiation is a phenomenon quite independent of emission of luminescence. C. A. S.

3329. Electrometric Potential and Concentration of Electrolytes. Suzanne Veil. *Comptes Rendus,* 202. *pp.* 1665–1666, *May* 18, 1936.—Denoting the electrometric potential [see Abstract 1338 (1936)] at concentration c by Π_c and that of a saturated solution (concentration s) by Π_s, if $\log(\Pi_s/\Pi_c)$ is plotted against $\log(s/c)$ for solutions of $CuCl_2$ a straight line is obtained indicating the relation $\Pi_c = \Pi_s(c/s)^K$, where K is a constant, which for $CuCl_2$ is approximately $= 1/6$. C. A. S.

3330. Behaviour of Cadmium Electrode in Alkaline Nickel-Cadmium Accumulator. G. Grube and E. Doetsch. *Zeits. f. Elektrochem.* 42. *pp.* 247–258, *May,* 1936.—The object of conducting the present research was to obtain a clear understanding of the behaviour of the negative mass in the alkaline Ni-Cd accumulator, consisting of a mixture of CdO and hammerscale. Concentration of electrolyte greatly influences the capacity of the Ni-Cd accumulator. The conclusions with regard to the Cd electrode are collected under two headings, with extensive experimental work, full supporting data and empirical curves. J. E. B.

3331. Kathodic Current Distribution in Galvanic Electrolytes. Part I. Zinc Baths. E. Mantzell. *Zeits. f. Elektrochem.* 42. *pp.* 303–315, *June,* 1936.—Previous work is continued in which the kathode was divided into sections, and the current distribution is measured in galvanic electrolytes [see Abstract 878 (1935)]. The method is applied to the case of Zn in six different electrolytes. The results are plotted on graphs showing the relationship between current and kathode surface. These curves show the distribution of the metal on the kathode. It is shown that the increase of distance between the electrodes only gives a more uniform distribution of the metal if the edge effect is entirely excluded. The effects of acidity and the addition of inorganic and organic substances are slight on both polarisation and current distribution. The best current distribution is obtained in cyanide baths. F. J. B.

3332. Physical Significance of Activity Coefficients in Reversible Electrode Equilibria. J. W. Belton. *Phil. Mag.* 21. *pp.* 1140–1144, *June,* 1936.—The activity coefficients of the electrolyte in the electrode-solution equilibrium are examined mathematically and their relations to the potential of ions adsorbed on the surface of the electrode are obtained. The view of the adsorbed layer is true only for dilute solutions but a comparison is drawn with concentrated solutions. Results, although not amenable to experimental verifications, are of reasonable order of magnitude. H. M. B.

3333. Acoustic-Electrochemical Phenomena. Part II. L. W. Nikitin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 2. 2. *pp.* 67–69, 1936. *In German.*—Previous experiments on the effect of sound on polarised electrodes [see Abstract 1248 (1935)] were carried out with iron electrodes, but the reproducibility of the effects with these electrodes was found to depend on certain conditions being fulfilled, which made it desirable to carry out experiments with Pt electrodes. The results obtained in these experiments show that the greatest sensitivity is obtained with solutions of concentration from $0\cdot001$ to $0\cdot0001$ *N*. Strong solutions gave no result. A sound-sensitive cell with Pt electrodes gave very good results with sounds of frequency 6000–8000 per sec. given by a whistle, the resulting telephone sounds being easily audible in an adjoining room. The solution used in the cell had $0\cdot5$ gm. NH_4Cl in 50 cm.^{3} of a 5 % NH_3 solution. When a twice normal H_2SO_4 solution was substituted for this the sensitivity of the cell to sound vanished completely. A. W.

3334. Experimental Test of Identity of Electrokinetic Potentials. R. DuBois and A. H. Roberts. *J. Phys. Chem.* 40. *pp.* 543–560, *April*, 1936.—Electroosmosis and streaming potential measurements were made with an optically polished glass slit in contact with conductivity water. The electrolytes were solutions of different valency types. The measurements were made over a range of concentrations from 10^{-3} *N* down to 10^{-6} *N*, that is the range of most rapid change of electrokinetic effects with concentration. The values of the ζ-potentials were calculated from the results. In the case of $AlCl_3$ solution of concentration 10^{-5} *N* it was found that the electrokinetic effects of electroosmosis and of streaming potential were of opposite sign. F. J. B.

3335. Theory of Electrokinetic Effects in Solution: Reactions between Ions. E. A. Moelwyn-Hughes. *Roy. Soc., Proc.* 155*A*. *pp.* 308–315, *June* 2, 1936.—Bimolecular reactions in solutions are regarded as having normal velocity when the velocity constant k equals $Z\cdot e^{-E_A/RT}$. E_A is the energy of activation given by the Arrhenius equation, and Z is a theoretical collision frequency. A measure of the abnormality in the rate of reaction is given by the term P in the equation $k = PZ\cdot e^{-E_A/RT}$. The study of ionic reactions has hitherto been confined almost enirely to measuring the relatively small change in rate brought about by changes in the concentration at a fixed temperature. The present paper deals with the absolute magnitude of the velocity, and attempts to interpret experimental values of P as high as 10^{+8} and as low as 10^{-7}. Attributing the deviation from normal behaviour to electrostatic attraction, for which the expression of Debye and Hückel is introduced, theoretical equations are derived for P, and for the variation of E_A with temperature and ionic strength, which appear to be in satisfactory agreement with experiment. AUTHOR.

See also Abstracts 2973, 2975, 2976, 3159, 3230, 3315.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

3336. Emission of Positrons. S. de Benedetti. *Ricerca Scientifica*, 1. *pp.* 192–201, *March*, 1936. *J. de Physique et le Radium*, 7. *pp.* 205–210, *May*, 1936.—The production of electron pairs (positive and negative) by the materialisation of the energy of the rays from a radioactive source is studied, using the trochoid method [see Abstract 1342 (1936)]. The results are in general agreement with theory. It is found that the emission is proportional to the square of the atomic number, and that the greater part is due to γ-rays. The high positron emission of a Th(B + C) source is confirmed. C. J. B. C.

3337. Emission of Positrons by Radioactive Sources. A. I. Alichanow, A. I. Alichanian and M. S. Kosodaew. *J. de Physique et le Radium*, 7. *pp.* 163–172, *April*, 1936.—Using a coincidence arrangement of two counters and semi-circular magnetic focusing, Th(C + C″) and RaC are found to emit one positron in about 3×10^4 disintegrations. The positrons are considered to arise (*a*) by internal conversion of the γ-rays, (*b*) by materialisation of the kinetic energy of β-particles at the instant of what would otherwise be β-disintegration. These results, and others on the distribution of energy among positrons emitted by Pb under γ-ray bombardment which show an asymmetry in the action of the nuclear field on the positron, agree with theoretical work of Jaeger and Hulme. The formula of Bethe and Heitler is in agreement with experiments on pair formation. The formation of pairs when fast β-particles from RaC fall upon matter is not confirmed. F. C. C.

3338. Conservation of Momentum in Positron Annihilation. A. J. Alichanjan, A. J. Alichanov and L. A. Arzimovič. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 1. 7. *pp.* 287–288, 1936. *In German.*—The coincidence method of Klemperer is developed to establish whether the two γ-ray quanta produced at the annihilation of a positron are emitted in opposite directions. The authors observe the coincidences which occur when two pairs of counters, one counter behind the other, are placed horizontally, one pair on each side of the source of positrons, and find that after allowing for coincidences due to cosmic rays, etc., this number is more than twice that observed when one pair of counters is moved to a position vertically above the source. They conclude that at an annihilation two quanta are emitted in opposing directions, according to the law of conservation of momentum. K. M. C.

3339. Production of γ-Rays by Annihilation of Positrons. G. Rumer. *Phys. Zeits. d. Sowjetunion*, 9. 4. *pp.* 317–327, 1936. *In German.*—The author calculates the probability that a positron emitted by a nucleus will be annihilated by collision with one of the electrons of the extranuclear atom, giving rise to a quantum of γ-radiation. This calculation is performed on the basis of Dirac's electron theory, a stream of positrons emitted by the nucleus being represented by a Dirac spherical wave function of positive energy, vanishing at infinity and possessing a singular point at the origin, while the electron is approximately represented by a Schrödinger function. The interaction of positron and electron is dealt with in the usual way, and the resulting γ-ray energy is calculated. K. M. C.

3340. Elastic Scattering of Slow Electrons from Organic Molecules. S. Hill and A. H. Woodcock. *Roy. Soc., Proc.* 155*A*. *pp.* 331–344, *June* 2, 1936.—Measurements have been made on the angular distributions of slow electrons, scattered elastically from CF_4, CCl_4 and CBr_4. The results are reviewed in terms of a theoretical treatment which combines the theories of Faxén and Holtsmark and of Debye. AUTHORS.

3341. Characteristics of the Immersion Objective for Image Formation with Fast Electrons. R. Behne. *Ann. d. Physik*, 26. 4. *pp.* 372–384, *June*, 1936.—Image formation by means of an electron optical "immersion objective" [see Abstract 483 (1935)] utilising electrons of

various energies is described. With a constant anode potential E_A and increasing electron energy E, the characteristic potential relation of the E_G/E_A (E_G = grid potential) decreases. The magnification for a constant object distance is dependent upon the electron energy E. For varying object distances the potential curves for constant E_A are parallel to one another. The potential field along the axis of the objective is not the same as when slow electrons are used; its distribution is briefly described.
H. J. H. S.

***3342. Uses of Kathode-Ray Oscillograph in Laboratory Demonstration. W. C. Bosch.** *Am. Phys. Teacher*, 4. *pp.* 81–85, *May*, 1936.—Small portable kathode-ray oscillographs are useful in the undergraduate laboratory to present integrated pictures of physical phenomena as well as for quantitative work. Experiments in sound and wave motion, and in a.c., transient and thermionic valve phenomena are described. AUTHOR.

See also Abstracts **2956, 2973, 2974, 2976, 2977, 2978, 3180, 3364.**

ELECTROSTATICS.

3343. Electrification of Liquids by Flow or Filtration. C. Reichart. *Comptes Rendus*, 202. *pp.* 1494–1495, *May* 4, 1936.—When non-conducting fluids flow they become charged. The author shows that in the case of lubricating oil the charge is at first negative, but later becomes positive. The p.d. obtainable is limited only by leakage through the liquid. Charges also result if the liquid is filtered, *e.g.*, through chamois leather. The effect of treating the oil with acids and bases is tried. Oil treated with acid can produce a p.d. up to 50,000 V. J. E. R. C.

3344. Volta Effect at Pure Metals. F. Krüger and G. Schulz. *Ann. d. Physik*, 26. 4. *pp.* 308–330, *June*, 1936.—The Volta effect has been measured for a series of metals by means of the method of the photoelectric saturation current in a cell of quartz glass, cements being avoided. Both electrodes could be heated in high vacua to free them from adhering water films and gas occlusions. The Volta p.d. between Pt and the metals W, Ta, Fe, Ni, Ag, Cu and Mo are measured during the prolonged glow of all parts in the best vacuum to ensure complete disappearance of foreign substances. By the introduction of moist air into the measuring vessel the effect is restored to its former value. The so-called chemical theory of the Volta effect for metals at room-temperature appears to be correct. It is assumed that for zinc at 160° the water film is not completely removed, since no appreciable decrease in the Volta effect is obtained. The photoelectric effect is also measured for the above metals, and this appears to run parallel in general with the Volta effect apart from the outset of the glowing process where disturbances occur. Full experimental details are included. H. H. Ho.

3345. Measurement of Contact Potential Difference. C. W. Oatley. *Roy. Soc., Proc.* 155*A*. *pp.* 218–234, *June* 2, 1936.—The methods of measuring contact p.d., which have been used hitherto, are discussed critically. A new method is described, which depends on the known relation between anode voltage and critical magnetic field in a magnetron, when electrons from the filament just fail to reach the anode. This method has the advantage that it enables the contact potential of a given surface to be measured with respect to a hot tungsten filament. The conditions under which it may be expected to be accurate are investigated in detail and typical results are given for surfaces of Zn and Mo. AUTHOR.

***3346. Electrostatic Generator. L. C. van Atta, C. M. van Atta, D. L. Northrup and R. J. van de Graaff.** *Phys. Rev.* 49. *pp.* 761–776, *May* 15, 1936.—The Round Hill electrostatic generator is described in detail, including the various belt charging systems. The measurement of voltage by means of a generating voltmeter is discussed with special reference to the precautions necessary to eliminate or to correct for sources of error. It is estimated that the probable error is less than 1 % on a relative scale and 2 % on an absolute scale. The voltage fluctuation is less than 0·1 %. The generator performance data are given graphically. The maximum charging current is 2·1 mA. The highest voltage obtained consistently without sparking is 2·4 megavolts positive and 2·7 megavolts negative, giving 5·1 megavolts between the terminals, the available current being 1·1 mA. C. J. B. C.

***3347. Torque of Sealed Electrostatic Voltmeter. E. H. W. Banner.** *Journ. Sci. Instruments*, 13. *pp.* 191–194, *June*, 1936.—A method is described of measuring the torque of an electrostatic voltmeter by measuring the capacitance C at different voltages at supply frequency. The capacitance can be measured for any voltage except zero, and from these figures are found values of $dC/d\theta$, where θ is the deflection, and so the torque is determined. When two air condensers are in series the voltage ratio is inversely proportional to the capacitances, neglecting leakage; if one of the condensers is an electrostatic voltmeter and the other a calibrated air condenser the capacitances are determined for given voltages across the voltmeter. Supply frequency is used, with special precautions to eliminate large possible errors due to stray capacitances and leakage. If the capacitance is measured at practically zero voltage by some bridge method the electrostatic efficiency may be determined in addition. An example is given. AUTHOR.

See also Abstract 3297.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3348. Demagnetisation of Rhombohedral Ferric Oxide. A. Michel. *Comptes Rendus*, 202. *pp.* 1769–1771, *May* 25, 1936.—The thermomagnetic curves for rhombohedral (α) Fe_2O_3 are irreversible, and show anomalies that differ according to the temperature at which the Fe_2O_3 has been previously heated, unless this has been for several hours at $\nless$ 1300°. Fe_2O_3 that has been thus heated gives a normal and reversible curve. [See Abstract **3651** (**1935**).] C. A. S.

See also Abstracts 3306, 3310.

MAGNETISM AND ELECTROMAGNETISM.

3349. Quantum Theory of Effect of Temperature on Magnetisation Curve. N. Akulov. *Zeits. f. Physik*, 100. 3–4. *pp.* 197–202, 1936.—The vector model of the quantum theory atom is applied to ferromagnetic single crystals, and it is shown that the difference in the energies of the crystal for the cases of resulting spin parallel to the directions of difficult and easy magnetisation is proportional to the tenth power of the saturation intensity. The expression obtained for the constant of anisotropy makes it possible to calculate the magnetisation curve for temperatures near the Curie point, if the saturation intensity is a known function of the temperature. G. E. A.

3350. Action of an Alternating Magnetic Field on Discs of Magnet Steel. J. L. Snoek. *Physica,* 3. *pp.* 361–370, *June,* 1936. *In English.*—The oscillations of a magnetised disc are usually quickly damped in both stationary and alternating fields, but the author describes oscillation experiments with small discs of magnet steel of 15 mm. dia., 0·25 mm. thick, coercive force about 500 G. and remanence about 450 C.G.S. in a homogeneous alternating field of 50 ∼ acting in the plane of the disc. Unless the system is carefully brought to rest in the equilibrium position the oscillations become stronger and stronger, eventually leading to rupture of the suspending wire. It is found that the origin of the torque is due to hysteresis, and it is shown that such a torque may be deduced from the form of the hysteresis curve if the amplitude of the field is of the order of the coercive force. A quantitative agreement between the experimental and theoretical torques proves that eddy currents play a negligible part, except at higher frequencies where eddy-current losses become appreciable. H. J. H. S.

3351. Magnetic and Electrical Properties of Ferrites. J. L. Snoek. *Physica,* 3. *pp.* 463–483, *June,* 1936. *In English.*—Magnetic and electrical measurements are made on the system $MO \cdot Fe_2O_3$ (M = Fe, Mn, Cu, Ni or Mg). Three methods are used to distinguish between the homogeneous phase and the 2-phase system. In the first, use is made of the fact that a heterogeneous phase is usually characterised by a higher coercive force; in the second, Curie point estimations show when the solubility limits are reached; in the third, the demagnetisation coefficients are deduced from the "ideal" curve (in this way very small amounts of a second non-magnetic component are detectable). These methods are applied to a study of the various types of "ferrite" system; the results are in close agreement with those derived from X-ray measurements.
H. J. H. S.

3352. Diamagnetism of Organic Binary Mixtures. S. Seely. *Phys. Rev.* 49. *pp.* 812–819, *June* 1, 1936.—Measurements of the magnetic susceptibilities of mixtures consisting of binary combinations of CCl_4, benzene and nitrobenzene, made with the improved manometric balance of Wills and Boeker over the range of temperatures from 10° C. to 50° C., are described. The results for mixtures of benzene and nitrobenzene each of which shows no variation of mass susceptibility with temperature, show that the principle of additivity of susceptibilities is valid within the limits of precision of measurement. For mixtures of either benzene or nitrobenzene with CCl_4, a systematic deviation from additivity is found. The deviations for both groups show a definite dependence upon both concentration and temperature. AUTHOR.

3353. Magnetic Susceptibilities of Organic Substances in Different Physical States. A. Bose. *Phil. Mag.* 21. *pp.* 1119–1125, *June,* 1936.—Within the limits of experimental error, the diamagnetic susceptibility of a compound is independent of its physical state, that is, independent of whether it is a single crystal, or is a molten liquid, or is in a state of solution. AUTHOR.

3354. Electric and Magnetic Inductivity. G. Giorgi. *Accad. Lincei, Atti,* 23. *pp.* 171–175, *Feb.* 2, 1936.—Referring to Puccianti's paper [*Accad. Lincei, Atti,* 21. *pp.* 732–739, 1935] relating to inductivity in relation to the introduction of systems with four fundamental units, the author discusses Puccianti's principal subject, the question whether the magnitudes denoted by ϵ_0 and μ_0 in empty space are to be recognised as physical magnitudes and if they have the character of specific properties of empty space itself and what nomenclature should in consequence be adopted. Macroscopic physics results from media formed from equations and values emerging from atomic physics, but this latter may depend on media formed upon some physics more profound that the future must reveal. Faraday's system in which certain parameters are regarded as having dimensions, and not simply as pure numbers, still renders useful service. In the case of atomic physics there is no doubt a surrounding medium which transmits electromagnetic actions and this is the empty space of ponderable matter. Across it move and react the active electric granules—electrons, positrons, protons or others, and the future must decide whether other media will be found in the interior of the corpuscles. With static or quasi-static phenomena Maxwell's reasonings may be neglected, but in the phenomena of radiation there occurs the energy of fields far distant from matter, and electromagnetic waves in this case are distinct from the bodies emitting them, otherwise the principle of the conservation of energy must be removed or electromagnetic energy supposed due to swarms of photons; or like views adopted. As to relativity: if free space cannot be a reference frame for velocity it may be for acceleration. There are certainly in every point-instant of space-time infinite inertial systems but the total is circumscribed, *i.e.*, not every system is inertial. The complex of the inertial platform appertaining to a single point-instant constitutes a local mechanical characteristic of empty space. Thus free space has *some* of the attributes of matter. There are two values of the space-ether that concern electromagnetism. These are well characterised and can be physically measured. They form two diverse pairs. One of these pairs consists of ϵ_0, μ_0; another is got from the velocity of light c and the asymptotic resistance, or irradiation resistance of space R. This last pair shows that the two physical data have dimensions, and involve a dimension comparable with those of mechanics, and another that may be considered independent. Experiment shows that $\epsilon_0 = 1/R_0c$; $\mu_0 = R_0/c$. Denoting by W_e and W_m the two energies per unit volume then $W_e = \epsilon_0 E^2/2$; $W_m = \mu_0 H^2/2$. Puccianti reaches the same conclusion by other reasoning. The author concludes by comparing his own point of view with Einstein's statements as to a region of space he calls "Galilean," with Sommerfeld's conclusions, and with those of Heaviside.

J. J. S.

See also Abstracts 2972, 2994, 3254, 3255.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3355. Effect of Electric Shock on the Heart. L. P. Ferris, B. G. King, P. W. Spence and H. B. Williams. *Elect. Engineering*, 55. *pp.* 498–515, *May*, 1936.—Tests show that the threshold value of current, above which sensation is experienced, is about 1 mA for 50- or 60-cycle current. Current above an uncertain value may cause ventricular fibrilation, which is a disruption of normal heart action, and may cause death within a few minutes. Tests were made to determine this current under given conditions and curves are given for current and various values of bodily weight, heart weight, frequency, duration and type of contact, etc. Electrocardiograms were also taken before and after the shock and recorded with the voltage and current used on a 3-string electromagnetic oscillograph. It was also found that the heart is only susceptible for about 20 %

of its cycle. Successful recoveries from ventricular fibrilation were obtained with several species of large animals by the application of a countershock for a short period, and at a high intensity. E. H. W. B.

3356. Soft Tissue Roentgenography. J. R. Carty. *Am. J. of Roentgenology and Radium Therapy*, 35. *pp.* 474–484, *April*, 1936.—Very soft radiographs are utilised not, as usually, to show bone detail, but to show soft tissues such as the structure of muscles, blood vessels, etc., the use of soft rays permitting differentiation of these soft tissues at the expense of detail of more dense tissues as the bone. Examples are given. B. J. L.

***3357. X-Ray Kymographs and Kymoscopes. W. G. Scott and S. Moore.** *Radiology*, 26. *pp.* 622–629, *May*, 1936.—Of recent years there has been widespread interest in radiological investigation by kymographic methods, in which movements of viscera are recorded, in respect of time, by a grid method. The present paper gives a detailed description, with numerous illustrations of such an instrument used in the Washington University School of Medicine, St. Louis. The particulars given are in sufficient detail to permit similar construction, the mechanical details being fully considered. B. J. L.

***3358. Powerful Monochromator for the Near Ultra-Violet. F. Benford.** *Gen. El. Rev.* 39. *pp.* 181–185, *April*, 1936.—A description of a special quartz mercury-vapour lamp having an arrangement of prisms to restrict the output wave-length as required, from about 2000 to 4000 Å, mainly for biological research. The Forsyth type of lamp [see Abstract 3610 (1933)] is referred to; in this lamp wave-length purity is the primary consideration but in the author's lamp maximum energy in the region of 4000 Å is the main consideration. The light is focused by lenses through two large Pellin-Broca prisms arranged on turntables so as to select the wave-length range to be transmitted, unwanted radiation being eliminated by refraction from the outer surfaces of the prisms. Output varies from 3400 μW at 3650 Å to 100 μW at 2652 Å. The optical arrangements are described in detail. Measurements of output are made with a thermopile at the output slit when required. E. H. W. B.

***3359. Five-Gramme Radium Pack. I. I. Kaplan.** *Am. J. of Roentgenology and Radium Therapy*, 35. *pp.* 498–507; *Disc.*, 517–521, *April*, 1936.—A description is given of the mode of use of a 5-gm. Ra pack in the Bellevue Hospital, New York, where the Ra is used in a special lead lined room. B. J. L.

***3360. Advantages and Disadvantages of Radium Packs. J. J. Duffy.** *Am. J. of Roentgenology and Radium Therapy*, 35. *pp.* 508–512; *Disc.*, 517–521, *April*, 1936.—Based on clinical experience, the advantages and disadvantages of cancer and other treatment with a large relative amount of Ra are discussed. It is stated that no data are available to prove or disprove the advantages of Ra rays over X-rays generated at high voltages, where attempts are being made to obtain an equivalent of shortness of wave-length by means of X-rays. The disadvantages of the Ra pack are largely mechanical, *i.e.*, the patients have to maintain uncomfortable positions during the irradiation. As compared to the more generally used 200-kV therapeutic apparatus the radium pack method appears to be more efficient, but attempts with higher X-ray voltages may modify future opinion and, as the supply of Ra is limited, further efforts in respect to higher X-ray voltages are advocated. B. J. L.

***3361. Advantages and Disadvantages of Radium Packs. B. T. Simpson and M. C. Reinhard.** *Am. J. of Roentgenology and Radium Therapy*, 35. *pp.* 513–517 ; *Disc.*, 517–521, *April*, 1936.—The ordinary 4 gm. Ra-pack, apart from original expense, has disadvantages in respect to lack of flexibility and treatment of small deep-seated areas. It is also very time consuming, owing to the lengthy irradiation necessary, which places severe strain upon the patient. In the present paper a particular form of pack is described in which, instead of a large single mass of Ra, this mass is divided into three portions and used in a container to permit cross-fire methods of irradiation, as commonly used in X-ray treatment. In practice, it is found that care has to be taken that the Ra does not move within the container, as this materially varies the spatial intensity of irradiation at a distance. The authors consider that such a pack, with a divided distribution of the radium element, has advantages over other methods of irradiation. B. J. L.

OSCILLATIONS AND WAVES.

3362. Relaxation Oscillations of Stable Frequency Obtained with Gasfilled Triodes. J. L. Eck. *J. de Physique et le Radium*, 7. *pp.* 227–232, *May*, 1936.—Gasfilled triodes can be used to produce relaxation oscillations whose amplitude depends on the negative voltage applied to the grid. The arrangement of apparatus for this purpose is very similar to that used with ordinary neon tubes. A study of the oscillations with gasfilled triodes shows that it is possible to obtain oscillations whose frequency remains, for a long interval of time, independent of the voltage applied between anode and kathode. To obtain this result all that is necessary is to polarise the grid to the mean of the charging current and to add to the polarisation thus obtained a fixed voltage determined by the characteristics of the particular triode used. The resulting constant frequency is due to the fact that the ignition voltage is a sensibly linear function of the grid polarisation. The amplitude of the oscillations, however, increases with the voltage applied between anode and kathode. The frequency of these oscillations is affected by the leakage resistances of the condensers used and can be utilised to measure such resistances with a close approximation. A. W.

3363. Effect of Electron Pressure on Plasma Electron Oscillations. E. G. Linder. *Phys. Rev.* 49. *pp.* 753–754, *May* 15, 1936.—A general equation for electron motion in a plasma is developed which includes a term arising from electron gas pressure. The resulting expression is $\delta^2\xi/\delta t^2 + (4\pi ne^2/m)\xi = (kT/m)\nabla^2\xi$, where ξ is electron displacement, n electron density, and T electron gas temperature. From this it is found that the possible frequencies of free vibration form a series given by $f_i = (kT/\lambda_i^2 m + ne^2/\pi m)^{\frac{1}{2}}$. The lower limit corresponds to the Tonks-Langmuir value $(ne^2/\pi m)^{\frac{1}{2}}$, while the other frequencies depend upon the possible standing waves which may exist. The theory explains the observed variation of frequency with electron gas temperature. AUTHOR.

3364. Simple Circuit for Oscillographic Frequency Comparisons. B. Kurrelmeyer. *Rev. Sci. Instruments*, 7. *pp.* 200–201, *May*, 1936.—A simple circuit is shown by which two frequencies N_1 and N_2 applied separately to the electrostatic deflection plates of a kathode-ray oscillograph produces circles on the fluorescent screen. The radius of the lower frequency circle should be at least half the screen and that of the higher frequency much smaller. When both voltages are applied simultaneously, the spot executes a path which may be considered as the smaller circle either rolling on or inside the larger one. If $N_1/N_2 = N$, an integer, the figure will be stationary with $N \pm 1$ points; if N is not an integer the figure will rotate, but the points may be counted by using a reversing prism, rotating at a known speed. H. M. B.

3365. Photographic Representation of a Hertzian Dipole. V. Arkadiev. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 1. 7. *pp.* 289–291, 1936. *In French.*—Near the centre of a spherical metallic mirror, an 11 mm. Hertzian oscillator is placed. The diffracted images of this are fixed on a sensitive paper by an electrochemical process [see Abstract 4995 (1934)]. A graph of the disposition of the points round the central image is compared with the theoretical Fraunhofer curve and found to be lower. Polarisation and the azimuthal distribution of the diffraction points are also considered. H. M. B.

3366. Voltage Measurement with a Lecher Wire System. N. N. Malov. *Phys. Zeits. d. Sowjetunion,* 9. 4. *pp.* 405–406, 1936. *In German.*—In a previous paper [see Abstract 1889 (1936)] theory was given of a method of voltage measurement by means of a Lecher wire system of variable wave resistance. It is here shown that similar measurements can be made with a Lecher system of constant wave resistance and the appropriate formulæ for this case are given. A. W.

***3367. Ionosphere Measurements. K. Maeda, M. Konomi and Y. Isagawa.** *Radio Research, Japan, Report,* 5. *pp.* 151–162, *Dec.,* 1935. *In English.*—This paper contains the results of measurements of the electron density in the E-region, together with a brief description of the measuring apparatus, used in the series of ionospheric investigations at the Electrotechnical Laboratory, Ministry of Communications. In the experiments, the critical frequency f_{EC} in the E-region was measured day and night. The seasonal variations in f_{EC} as measured at noon are compared with the results obtained by Appleton, and the diurnal variations in f_{EC} is also described. Results of studies of the so-called "sporadic E-region" are given, showing the characteristics of the abnormal state of the E-region and its effect on the propagation of radio waves at frequencies from about 1000–6000 kc./sec. Data on the spread of the sporadic E-region are also added. Observations made during the night show that f_{EC} increases instead of uniformly decreasing, appearing to pulsate with a certain period. AUTHORS.

3368. Oblique Propagation of Electromagnetic Waves in a Non-Isotropic Medium. H. G. Booker. *Roy. Soc., Proc.* 155*A. pp.* 235–257, *June* 2, 1936.—A solution of the Maxwell-Hartree differential equations for any slowly-varying non-isotropic medium is investigated with a view to applying the results to the ionosphere. A plane wave incident upon the ionosphere is in general split up into two magneto-ionic components each of which is propagated independently. The type of propagation experienced by these components is approximately the same as that of the characteristic waves in the homogeneous medium appropriate to their height. The critical electron density for reflection is calculated by expressing the condition that the direction of energy-propagation, *not* phase-propagation, is horizontal. A method for determining the limiting polarisation of downcoming wireless waves is also investigated. The paper is wholly mathematical. R. M.

See also Abstract 3290.

PHOTOELECTRICITY.

3369. Continuous Absorption and the Photoelectric Effect. H. Rakshit. *Zeits. f. Physik,* 100. 5–6. *pp.* 396–400, 1936.—Fleming's suggestion that the almost immediate commencement of the emission of photoelectrons following the incidence of light may be explained without recourse to quantum theory as a process similar to the absorption of light by a radio antenna, is examined critically. It is shown on certain assumptions that a Hertz oscillator of atomic dimensions might absorb in the manner of a radio aerial enough light to emit a photoelectron in a time of the order of 10^{-8} sec. Experiments show, however, that photoelectrons are emitted after $3 \cdot 10^{-9}$ sec. following incidence of the light. It is concluded that Fleming's suggestion does not overcome the difficulty of the classical theory. W. S. S.

3370. Photoelectric Sensitivity of Pd-Ag Alloys Saturated with Hydrogen. F. Krüger and W. Kallenbach. *Zeits. f. Physik,* 99. 11–12. *pp.* 743–750, 1936.—Measurements are taken of the photoelectric sensitivity, both with monochromatic and with undispersed light from a Hg lamp, of Pd-Ag alloys which have been saturated with H_2 for various times up to 30 hr., with different values of the Ag content. Maxima are found for 20 % and 60 % Ag. Unpublished results are quoted showing that the variation with composition of the amount of H_2 absorbed by these alloys after about 30 hr. exposure also shows a maximum at approximately 20 % and 60 % Ag. The readings of the monochromatic light show that the maxima of sensitivity are not due to an extension of the spectral sensitivity to cover the bright Hg line 3130 Å, as has been suggested elsewhere. D. H. F.

3371. Photoelectric Investigation of Semiconductors. L. Bergmann and J. Hänsler. *Zeits. f. Physik,* 100. 1–2. *pp.* 50–79, 1936. —Employing a very sensitive method, the authors investigate the internal photoelectric effect for a large number of semiconductors, whereby under the influence of light in the substance concerned and without any external electric field a movement of electrons sets in. The motion of the electrons under the influence of the light takes place partly in the direction of the incident light, analogous to Dember's crystal photo-effect, and partly in the reverse direction. The spectral distribution of this photoelectric effect is measured and the dependence on the optic absorption, wave-length and molecular weight is studied for several substances. The photoelectric maximum for several substances is found to be at the long-wave limit of the optic absorption band. R. L.

3372. Velocity Distribution of Photoelectrons from Composite Cæsium Kathodes. A. I. Pjatnitzki and P. W. Timofeew. *Phys. Zeits. d. Sowjetunion,* 9. 2–3. *pp.* 187–197, 1936. *In German.*—Using the opposing electric field method, measurements are made upon the velocity distribution of the photoelectrons from composite oxygen-cæsium and sulphur-cæsium kathodes. It is found that the distribution depends upon (i) the wave-length of the irradiating light and (ii) the structure of the kathode. The data are considered to support the view that the photoelectric effect at composite kathodes is due to photo-ionisation of adsorbed alkali metal vapour. L. A. W.

3373. Time-Lag in Dark Discharge in Gasfilled Photo-Cells. F. M. Penning. *Physica,* 3. *pp.* 563–568, *June,* 1936. *In German.*—In certain gasfilled photo-cells the self-maintained discharge starts in absolute darkness only with a time lag, depending on the applied voltage. A very small illumination diminishes this time lag considerably. Below the starting potential a current due to thermionic emission of the kathode is flowing, the characteristic showing peculiar discontinuities. These phenomena are explained by the influence of the cell window acting as a third electrode with a large coefficient of secondary emission. When due attention is paid to the influence of a preceding discharge, the time lag diminishes as the temperature of the cell is increased. AUTHOR.

3374. Photoelectric Effect in Coloured Rochelle Salt. F. Seidl. *Zeits. f. Physik*, 99. 9–10. *pp.* 633–634, 1936.—Rochelle salt to which a yellowish tinge had been imparted by X-rays or γ-rays [see Abstract 903 (1936)] is subjected to the influence of light, and the resulting photo-e.m.f. is observed by means of an electrometer. There is no quick response, but only a slowly increasing deflection. This result points to the absence of the primary photoelectric effect, and to the existence of a secondary effect. The measurements are made at a temperature of about 24° C. P. V.

See also Abstracts **3163, 3302, 3305, 3328, 3344.**

PIEZOELECTRICITY.

3375. Inverse Piezoelectric Properties of Rochelle Salt at Audio Frequencies. O. Norgorden. *Phys. Rev.* 49. *pp.* 820–828, *June* 1, 1936.—The piezoelectric dilatation is measured as a function of the temperature and of the frequency and intensity of the applied electric potential. Within certain limits it is proportional to the electric force, and for temperatures betweeen 13·3° C. and 35·4° C. it is practically independent of frequency in the range 100–4000 ∼. For frequencies below 100 ∼ the piezoelectric dilatation decreased or increased with increase of frequency according as the temperature was below or above the Curie point, 23·8° C. The results obtained are in approximate agreement with Mueller's theory for temperatures between 13·3° C. and the Curie point, and for frequencies between 100 and 4000 ∼, but not for lower frequencies. P. V.

THERMIONICS.

3376. Short-Time Loading Method of Measuring Emission Currents. J. Groszkowski and S. Rżyko. *Zeits. f. techn. Physik*, 17. 5. *pp.* 155–159, 1936.—Methods used to measure the emission currents from kathodes of high emissivity are based on short period loading of the kathode [see Abstract **4743** (1935)]. Since large errors may creep in, due to the kathode not gaining its maximum temperature, also through energy loss due to emitted electrons, experiments with a kathode-ray oscillograph are described which show that the time to stabilise the kathode depends on its strength and that this time should be allowed to elapse before measurements are made. H. M. B.

See also Abstract **2944.**

THERMOELECTRICITY.

3377. Peltier Effect in Cu-Cu$_2$O-Cu Element. G. Mönch. *Zeits. f. Physik*, 100. 5–6. *pp.* 321–325, 1936.—The Peltier effect at the boundary Cu-Cu$_2$O is measured, by observing the thermo-e.m.f. set up by the passage of a current, and its variation with temperature studied. Proportionality to absolute temperature, in accordance with theory, is shown. D. H. F.